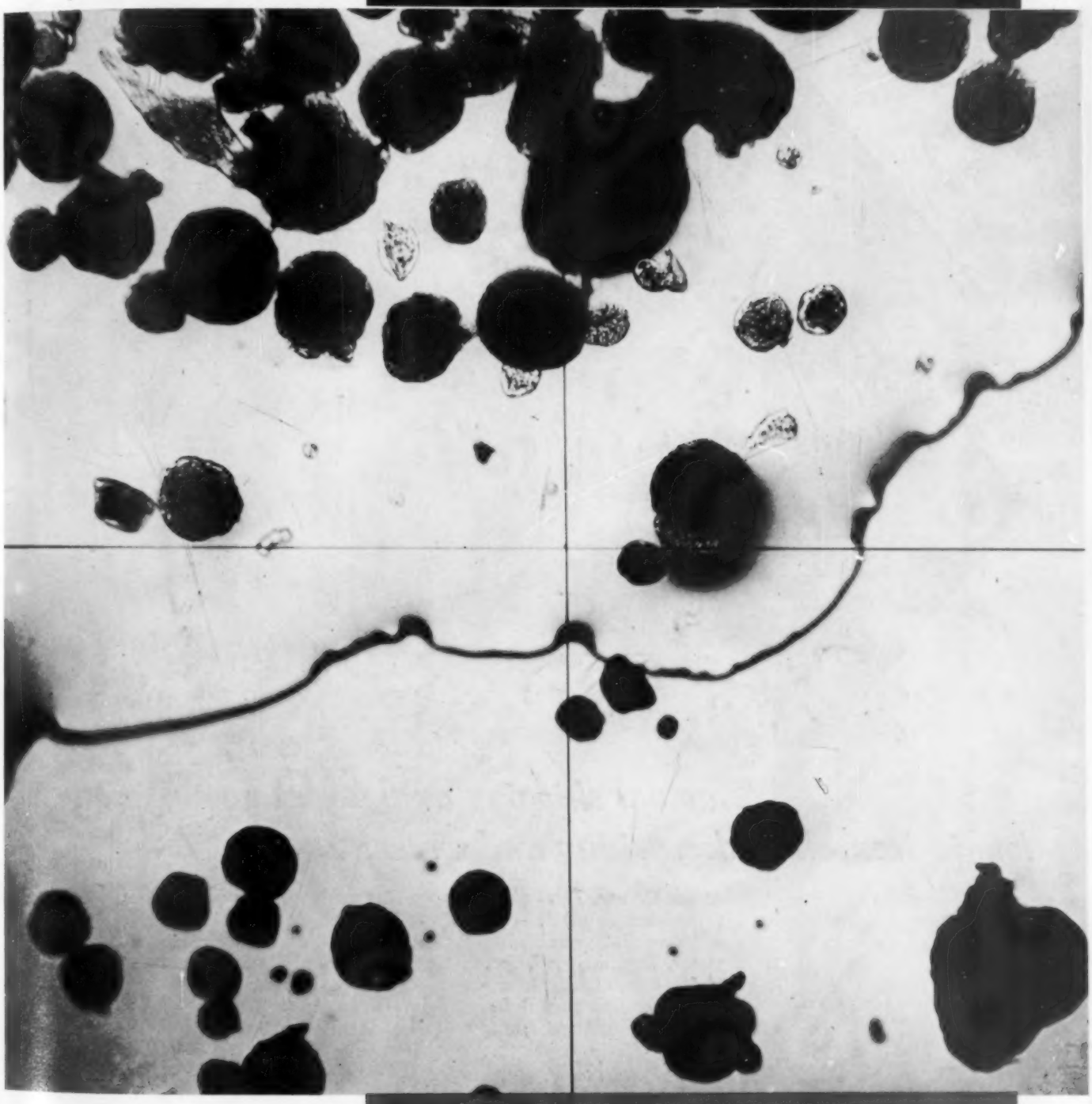
UNIV RS IY
OF MICHIGAN
JUN 28 1956
AST ENGINEERING
LIBRARY

JUNE 1956

PLASTICS TECHNOLOGY

THE MAGAZINE OF APPLIED ENGINEERING

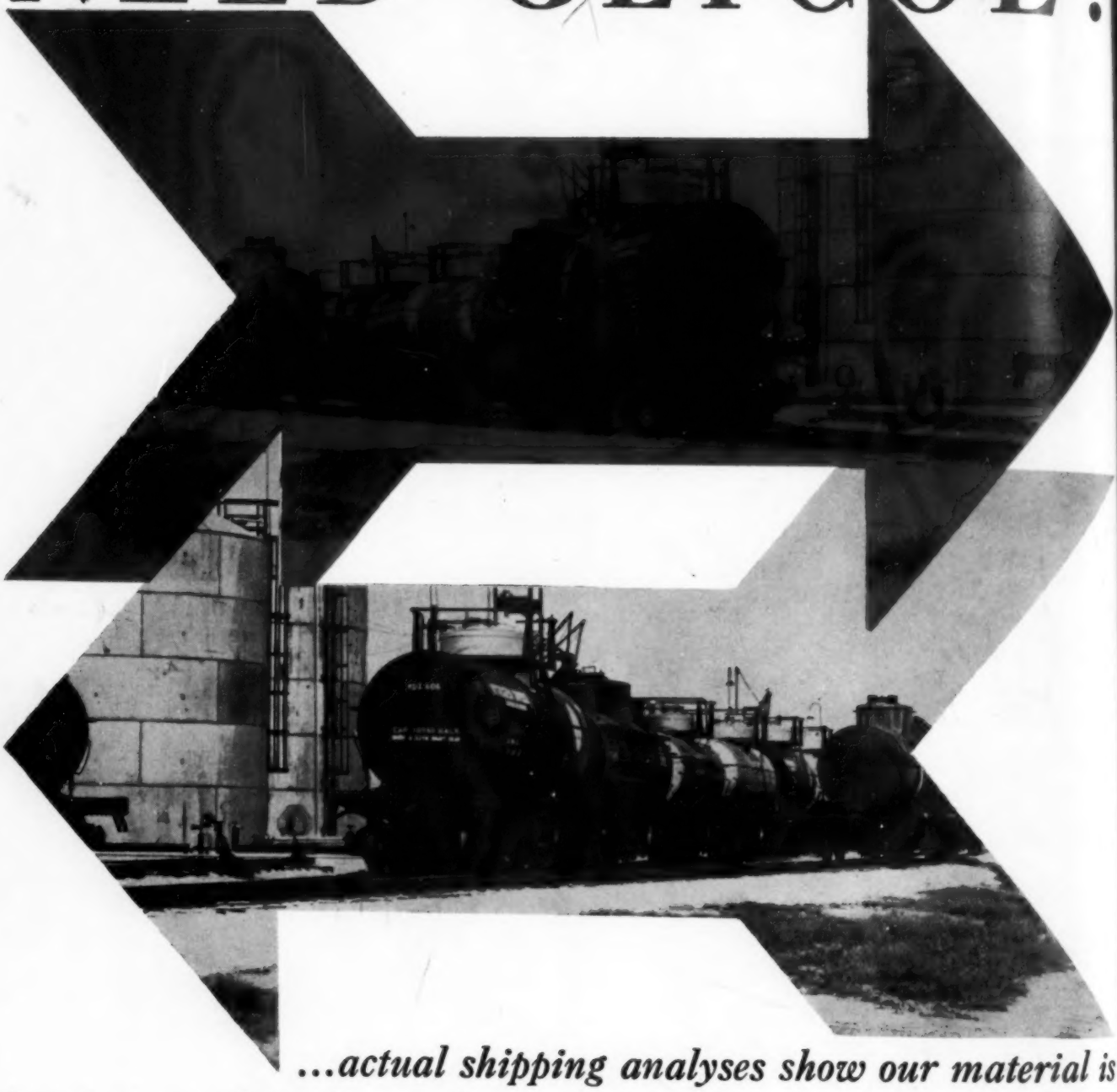


PHOTOMICROGRAPH OF NORMAL PLASTICIZER ACCEPTANCE BY VINYL RESIN PARTICLES

See article by M. R. Rector/page 390

A BILL BROTHERS PUBLICATION

NEED GLYCOL?



...actual shipping analyses show our material is low in iron, chlorides, acidity and water!

At our Orange, Texas plant – one of the world's most modern petrochemicals plants – we employ the most advanced processes to turn out ethylene, diethylene and triethylene glycol of the highest commercial purity. They are available in bulk from the plant in 4, 6, 8 and 10,000-gallon tank cars or barges – and in L.C.L. shipments (drums or tank trucks) from Edgewater, N. J.; New York, N. Y.; Boston; Chicago; Los Angeles; and other key industrial points.

Dept. G 2-23-2

Allied Chemical — NITROGEN DIVISION

40 Rector Street, New York 6, N. Y.

Write for a typical analysis, price quotation, free sample, or technical service.

Ethanolamines • Ethylene Oxide • Ethylene Glycols • Urea • Formaldehyde • U. F. Concentrate—85 • Anhydrous Ammonia • Ammonia Liquor • Ammonium Sulfate • Sodium Nitrate • Methanol • Nitrogen Tetroxide • Nitrogen Solutions • Fertilizers & Feed Supplements

PLASTICS TECHNOLOGY, published monthly by BILL BROTHERS PUBLISHING CORPORATION. Office of Publication, 1309 Noble Street, Philadelphia, Pa., with Editorial and Executive Offices at 386 Fourth Avenue, New York 16, N. Y. Subscriptions in United States and possessions and Canada $5.00 per year. All other countries $10.00. Accepted as controlled circulation publication at Philadelphia, Pa. Copyright 1956 by Bill Brothers Publishing Corporation

THE MAGAZINE OF APPLIED ENGINEERING

PLASTICS TECHNOLOGY

PUBLISHER
RAYMOND BILL

FREDERICK C. KENDALL
Vice President

•

EDITORS
ARTHUR M. MERRILL
Editor

ROBERT G. SEAMAN
Executive Editor

JAMES T. DUGAN
Assistant Editor

BARBARA GERLINGS
Editorial Assistant

L. THAKAR
Foreign Editor

EDITORIAL ADVISORY BOARD

Materials
C. H. ADAMS
D. L. SCHOENE
G. B. THAYER

Moldmaking
E. J. CSASZAR

Processing
SAUL BLITZ
JOHN BOLTEN, JR.
H. T. DOUGLAS
A. A. KAUFMAN
J. H. WOODRUFF

Equipment
H. E. BUECKEN
A. J. DEMATTEO
E. H. JOHNSON

•

BUSINESS STAFF
ROBERT B. CARTER
Business Manager

LEE R. NOE
Eastern Representative
386 Fourth Avenue
New York 16, N.Y.
LExington 2-1760

WILLIAM T. BISSON
Mid-West Sales Manager
163 West Exchange Street, Room #7
Akron 2, Ohio

C. E. LOVEJOY, JR.
Western Manager
333 N. Michigan Ave., Chicago 1, Ill.
STate 2-1266

ROBERT E. AHRENSDORF
Pacific Coast Representative
1140 Wilshire Blvd., Los Angeles 17
MAdison 9-2681

ALBERT R. WILSON
Circulation Manager

FRANCES Y. McHUGH
Production Manager

JUNE, 1956
VOLUME II, NUMBER 6

PLASTIC FOAMS—THEIR RELATIONSHIP AND COMPETITIVE PICTURE
Joseph J. Hirsh 377
A realistic appraisal of the preparation, properties, advantages, and shortcomings of plastic foams in comparison with rubber latex foam.

PROPERTIES AND APPLICATIONS OF BUTYRATE PIPE
L. W. A. Meyer and R. J. Scogin 382
A discussion of the composition, properties, creep data, fittings, fabrication, installation, and applications of the pipe.

HI-FAX, A NEW ETHYLENE POLYMER ..... Elmer Hinner 388
A GUEST EDITORIAL

CAUSES OF FISH-EYES IN VINYL ARTICLES ..... Marion R. Rector 390
Causative factors behind the formation of fish-eyes or gels in vinyl surfaces, and the role played by plasticizer absorption of the resin.

VINYLS GIVE VOICE TO TALKING TOYS 393

RECENT DEVELOPMENTS AND CURRENT PROBLEMS IN PLASTIC TOOLING ..... Benjamin Sokol 394
A detailed discussion of recent developments, current problems, and the future outlook for plastic tooling.

STORING AND HANDLING POLYESTER RESINS IN BULK 400

FEATURE DEPARTMENTS

Letters to the Editor	360	New Materials	413
News in Brief	369	New Equipment	416
Editorial	375	New Products	418
News of the Societies	404	New Literature	420
Calendar of Coming Events	428	Book Reviews	421
News of the Industry	406	Abstracts of Important Articles	422
News from Abroad	410	Patent Digest	424
Names in the News	411	Resins: Production and Sales	427
Obituaries	412	Current Market Prices	426

Published monthly by
Plastics Technology Publishing Corp., a Division of
BILL BROTHERS PUBLISHING CORPORATION
NBP BPA 386 Fourth Avenue, New York 16, N. Y.

BILL BROTHERS PUBLICATIONS

President and Chairman of the Board, Raymond Bill. Treasurer, Ralph L. Wilson. Vice Presidents, B. Brittain Wilson, C. Ernest Lovejoy, Wm. H. McCleary. Editorial and Executive Offices, 386 Fourth Ave., New York 16, N. Y. LExington 2-1760. Subscription Price: United States and Possessions and Canada, $5.00 per year. All other countries, $10.00. Single copies in the U. S. 50¢; elsewhere, 75¢; Other Bill Brothers Publications: In Industry: Rubber World. In Marketing: Sales Management, Sales Meetings, Tide, Premium Practice. In Merchandising: Floor Covering Profits, Fountain & Fast Food, Grocer-Graphic, Tires-TBA Merchandising, Yankee Grocer. Members of National Business Publications, Inc.

Flexricin®
"MULTIPLE DUTY" PLASTICIZERS
with the
built-in lubricity factor make vinyl compounding easier

for

- anti-blocking properties
- faster calendering and extrusion
- elimination of other lubricants
- thorough pigment and filler wetting
- improved color in pigmented stocks
- retained low viscosity in plastisols
- outstanding low temperature flexibility

choose

FLEXRICIN P-4 Best secondary plasticizer for general compounding

FLEXRICIN 66 Tops for retention of low plastisol viscosity

FLEXRICIN P-8 Excellent electrical properties; ideal for wire coatings

•

BAKER STABILIZERS
also make compounding easier by imparting effective processing lubrication—moreover contribute to longer life of finished goods.

BVS® (Barium Ricinoleate)
Cadmium Ricinoleate
Calcium Ricinoleate (non-toxic)

For further information on these compounding materials write Dept. PT66.

The BAKER Castor Oil Co.
120 BROADWAY, NEW YORK 5, N. Y.

Letters to the Editor

Questions Kellogg's Claim

Dear Sir:

The April issue contains a small article under the title, "Fluorocarbon-Glass Laminate." The first sentence ends with the claim of its having been ". . . developed by M. W. Kellogg Co."

Fluorocarbon-glass laminate as described was first developed by a firm in general, myself in particular, and is so produced. Of this, the firm of M. W. Kellogg Co. is well aware, and any such claims by them are in the face of facts to the contrary.

Armen Garabedian,
Armen, Inc., Long Island City, N. Y.

(The article referred to is a New Product item, entitled "Fluorocarbon-Glass Laminate," which appeared on page 264 of the April issue, and was based on information supplied by Kellogg. As an impartial judge, we must state that the item does not imply exclusive development by Kellogg of the class of laminate in question.—Editor)

• • •

Correction to Letter

Dear Sir:

In your printed version of my letter on polyethylene nomenclature, there has been omitted one single character on which the whole meaning of a sentence depends.

With it restored, my fifth paragraph reads: "We quite agree with your assertion that 'polymethylene' cannot be considered at all for a molecule made from ethylene."

Frank C. McGrew, Asst. Research Director,
E. I. du Pont de Nemours & Co.
Wilmington, Del.

(Our abject apologies to Dr. McGrew for the error in our printed version of his letter on page 206 of our April issue. Our version said "polyethylene" instead of "polymethylene." We must have been the victims of a polymethylene gremlin.—Editor)

• • •

Wants Desk Signs

Dear Sir:

Can you tell us how to locate a source of supply for an ordinary plastic desk sign, either to screw into the side of the desk or an easel type, and reading Notary or Notary Public?

We understand that this is a stock item, yet those who have quoted talk about custom work. Apparently we are not contacting the right places.

W. J. McGraw Stamp Co.
Jamaica Plain, Mass.

(Suggestions have been sent to the inquirer, but this letter is being printed to elicit further replies from our readers. —Editor)

• • •

Copies of Articles

Dear Sir:

I believe you have had in your first issue an article on the coating of polyethylene. I would appreciate your sending us a copy of this issue.

Edward W. Carlson
Commonwealth Plastics Corp.
Leominster, Mass.

(Stocks of our first issue, February 1955, have been exhausted, but we were able to send Mr. Carlson a tearsheet copy of the article in question. This latter is printed to remind our readers that tearsheet copies of our articles are furnished without charge, when available.—Editor)

• • •

Who Makes Barcol Tester?

Dear Sir:

Occasional reference to the Barcol Test as a measure of the hardness of plastic materials has created interest. Will you send the details of the Barcol Hardness test, or advise regarding where this information can be obtained?

R. A. Baumgartner, Devel. Engineer.
Organic Bonded Abrasives Division.
The Carborundum Co.
Niagara Falls, N. Y.

(The Barcol Impressor or hardness tester is made by the Barber Colman Co.,

Rockford, Ill., and operates on a principle closely related to that of the Shore Durometer. Detailed information on the tester and its operation can be obtained from the manufacturer.—Editor)

• • •

Plastic Boxes Wanted

Dear Sir:

I am looking for a plastic box, 3¼ by 2½ by 1¼ inches, with a slip-on top. Possibly there is among your advertisers a company who could supply me with such a box. Your help will be appreciated.

Leo J. Bergmann
Jay Engineering & Development Co., Bergenfield, N. J.

(A list of possible suppliers of such boxes, and other possible sources of help, have been sent to the inquirer. Additional sources of supply are invited from our readers.—Editor)

• • •

Plastic Tops for Machine Stands

We are currently making typewriter stands and business machine stands and would like to go to an all-plastic top, using various sizes and different colors.

Would you be kind enough to send me a list of manufacturers making this type of material and product who are located close to our town. We are just 17 miles north of Ft. Wayne, Ind.

Bruce E. Herbolsheimer
Hardware Engineering Co., Inc.
Garrett, Indiana

(A list of possible manufacturers of reinforced or laminated plastic tops for the machine stands in question has been sent to the inquirer.—Editor)

• • •

We invite letters from our readers for publication in these columns. Such letters may be of comment or criticism, requests for information, or of general interest. The only requirement is that all letters must be fully identified as to name of sender, company affiliation, and address.

Letters requesting information on technical or engineering problems will be printed to elicit replies by the readers, either directly or through these columns. Upon request the identities of such "problem" letters will not be divulged.

—The Editor

Good medicine for vinyl stabilization problems!

ORGANO-TIN STABILIZERS

For better vinyl stabilization at no additional cost... greater thermal protection...improved production quality and efficiency—investigate the THERMOLITE family, M & T's complete line of organo-tin stabilizers. More and more producers of vinyl products are switching to THERMOLITE stabilizer blends for their particular formulations and getting more working material per dollar invested in stabilizer.

TONIC FOR VINYL TILES

Several manufacturers of vinyl floor covering have solved production difficulties with the help of M & T research and products. Recently one of the nation's largest consulted us about a stabilization problem—their requirement for a system that would be non-staining and non-lubricating...possess good heat and light stability...be low in cost...and be compatible with a napthol red pigment essential to manufacture. After exacting tests THERMOLITE stabilizer blends proved to exceed specifications. They *alone* solved the problem.

HOW TO SATISFY *YOUR* REQUIREMENTS

Send us details of your stabilizer needs. We'll help you find the answer. Our service goes beyond the usual research and development assistance.

METAL & THERMIT CORPORATION
GENERAL OFFICES: RAHWAY, N. J.

TIN & TIN CHEMICALS • CERAMIC MATERIALS • ORGANIC COATINGS • WELDING SUPPLIES
RADIOGRAPHIC EQUIPMENT • PLATING MATERIALS • METALS & ALLOYS • HEAVY MELTING SCRAP

THE MARK OF QUALITY

BARBER COLMAN

Wheelco Instruments

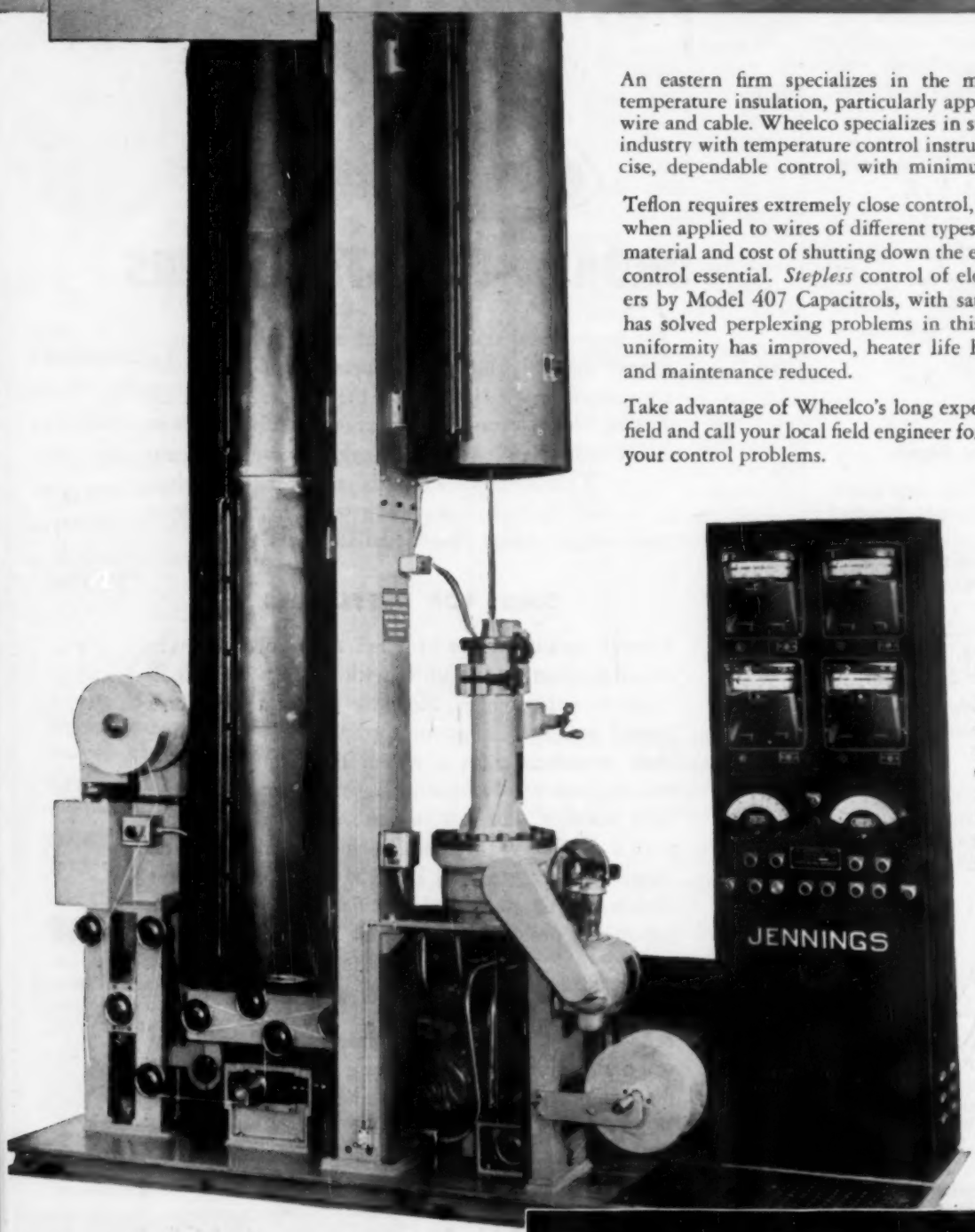
Model 407 Capacitrol controls Teflon extrusion — exactly!

MORE THAN 80% of the plastic molders in the New York area have expressed their preference for Wheelco Instruments. Wherever plastic machines are used, Wheelco furnishes precise, dependable control at low cost.

An eastern firm specializes in the manufacture of high temperature insulation, particularly application of Teflon to wire and cable. Wheelco specializes in supplying the plastics industry with temperature control instruments that offer precise, dependable control, with minimum maintenance.

Teflon requires extremely close control, at high temperatures when applied to wires of different types. Expense of the raw material and cost of shutting down the extruder make perfect control essential. *Stepless* control of electric resistance heaters by Model 407 Capacitrols, with saturable core reactors, has solved perplexing problems in this operation. Product uniformity has improved, heater life has been lengthened, and maintenance reduced.

Take advantage of Wheelco's long experience in the plastics field and call your local field engineer for assistance in solving your control problems.



Model 407 Capacitrol controls this Jennings extruder, maintaining operating temperatures at exactly 800 F. Heater life is lengthened and maintenance reduced.

WHEELCO INSTRUMENTS DIVISION

Barber-Colman Company

ROCKFORD, ILLINOIS DEPT. F, 1565 ROCK STREET

BARBER-COLMAN of CANADA, Ltd., Dept. E, Toronto and Montreal, Canada

NEWS in BRIEF

New epoxides can be made by a commercially-feasible process developed by Carbide & Carbon Chemicals. The process covers the manufacture of peracetic acid from acetaldehyde. To date, more than 375 epoxides have been made with the process, and still more are under investigation.

New standard on reinforced plastic sheet laminates for mechanical and electrical applications has been adopted by NEMA, ASTM, and SPI. The standard, GPO-1, follows existing NEMA standards for phenolic and melamine sheets, and requires the elevated-temperature properties typical of Class B electrical insulation.

Hercules' new ethylene polymer, Hi-fax, is discussed by Elmer Hinner, manager of the company's cellulose products dept. (see guest editorial, pages 388-9). A low-pressure polyethylene, the material is expected to enter the general fields of injection molding and extrusion, and offer improvements in quality of many items now being made of other plastics.

Company developments described this month include purchases, reorganizations, and trademark changes. American Cyanamid has purchased Formica and will operate it as a subsidiary, with no changes in former management. Cyanamid also announced the adoption of a new trademark, Cymel, for its melamine molding compounds and resins; the old designation, Melmac, will apply only to molded melamine dinnerware. Emery Industries has formed two sales departments, organic chemicals and fatty acids, replacing the previous single sales organization. General Tire has integrated the recently-purchased Forrest Process & Development Corp. into its Textileather Division. Manufactured Products Corp. is the new name for the former plastics division of Colt's Mfg., now a wholly-owned subsidiary of Penn-Texas. Trinity Products, a new firm, has been organized to absorb the former Texas Plastic Development Corp. Durable Formed Products and Speck Plastics have signed a working agreement.

Company expansions in plastics continue unchecked. Cyanamid is expanding its New Orleans, La., plant; the first phase, a monomethyl styrene unit, has been completed. American Plastics will further expand its molding plant at Bainbridge, N. Y., by 50%. A formaldehyde and synthetic resin plant is being constructed by Borden at Fayetteville, N. C. Several units of Union Carbide's new silicones division plant in Long Reach, W. Va., are now in operation. A multi-million dollar plant for manufacture of its new rigid polyolefin resin is planned by Celanese near Houston, Tex. Dow has purchased land near Baton Rouge, La., on which to build new chemical facilities. Durez will add three stories to its North Tonawanda, N. Y., plant for a product application lab. Grace's polymer chemicals division is setting up headquarters and application labs in Clifton, N. J.
Monsanto has more than doubled Opalon vinyl production. St. Regis Paper has expanded its subsidiary, Chester Packaging Products, and affiliates.

New Materials of interest (see pages 413-5): oleic acid plasticizer intermediate; molybdenum disulfide-filled nylon molding powder; two vinyl plasticizers; aldol-type chemical intermediate; polymerizable allyl monomer; plasticizer for cellulosics; polyurethane prepolymer; four epoxy coating resins; silicone-modified nitrile rubber for curing bags; and four new chlorofluorocarbons.

New Equipment to be noted (see pages 416-7): three automatic compression presses; automatic drape and vacuum forming machine; agitator belt drive units; 4-oz. automatic injection machine; polyliner-type extension nozles; and electric bayonet saw cutters.

New Products that merit attention (see pages 418-9): molded PVC plug valves with Teflon bearing buttons; Dacron-filled pillows with polyurethane foam covers; molded butyrate handles for hacksaw frames; 3-D shadow-box displays of transparent, printed acetate; extruded butyrate lighting panels; fibrous glass-polyester side racks for flat-bed truck trailers; waterproof contact cement for plastic laminates; polyethylene beach sandals; Mylar-felt combination fabric; and three epoxy-based structural adhesives.

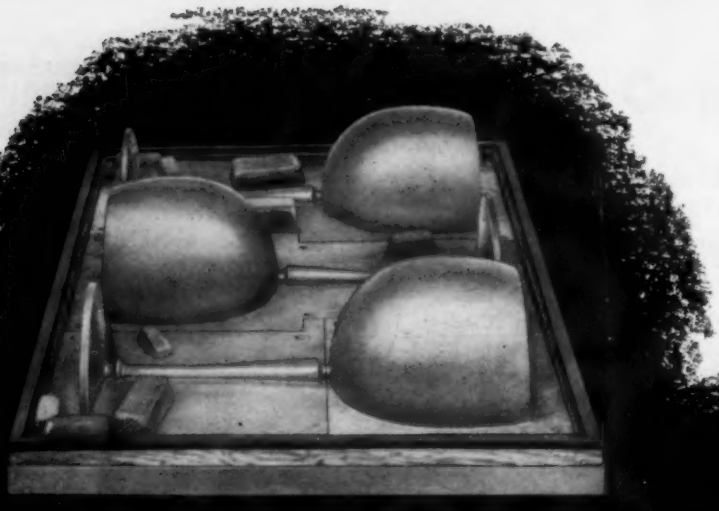


Photo courtesy
Pacific Plasti-Fab Corp.

The TOUGH molding jobs come out Easy ...with METASAP® STEARATES!

Jobs come out of the mold far easier—even the deep draws, intricate shapes and large-size moldings...because Metasap stearates give you better mold lubrication, quicker parting action. With these stearates you can easily use lower ejection pressures—to boost your production and get better finished pieces...at the same time cutting down rejects and gaining longer mold life!

Just mix Metasap stearate into your molding powder... or dust lightly on the mold. And Metasap technical service will gladly help you select the proper stearate and mix procedure for your needs. Write today for full information and samples.

Want to produce ECONOMICAL plastigels?

As a thickening agent for plastigels, Metasap stearates bring you many advantages—and a complete line of top quality stearates to meet your every need. We'll gladly send you experimental samples of magnesium, calcium and aluminum stearates.

METASAP CHEMICAL COMPANY

METASAP CHEMICAL COMPANY

HARRISON, NEW JERSEY • Chicago, Ill.
Boston, Mass. • Cedartown, Ga. • Richmond, Calif.

the cleanest stearates made

A NOPCO Subsidiary

PLASTICS TECHNOLOGY

JUNE, 1956

EDITORIAL: Sharing Industry Responsibilities—III

Concluding the discussion begun in our April editorial, we have pointed out that the plastics industry consists essentially of two major groups, the materials suppliers and the plastic processors, each with related stakes in the service success or failure of plastic products and the future growth of the plastics industry.

As a corollary, each group of the industry has certain responsibilities to themselves, to each other, and to users of plastics. However, both groups have been quite successful in ignoring or even flouting their responsibilities, thus hindering the growth of the industry and, consequently, harming themselves.

•

Plastics in consumer goods have suffered from poor public opinion based on countless misapplications, both deliberate and unintentional. For these, both materials suppliers and plastic processors are to blame; the former for the unintentional misapplications resulting from insufficient technical data on the materials, and the latter for the deliberate misapplications resulting from "get rich quick" and "let the buyer beware" attitudes.

Both groups, however, are quick to hail the steady gains made by plastics in industrial applications. It is true that some of these successful uses were originated and developed by companies in the plastics industry. On the other hand, many others reflect only the engineering abilities of the user company rather than those of the plastics industry.

A manufacturer of a fabricated product who contemplates use of a plastic component will have his materials engineers investigate the various plastics to determine their suitability for his application. From the different plastic materials suppliers, the engineers will obtain technical data, both published and semi-confidential, that permits choice of a material possessing the properties needed for the service requirements of the component.

After tests to confirm his choice of material, the prospective user will obtain trial parts from a processor who makes them in acccordance with the user's specifications and design. These parts are given further tests and, if acceptable, are ordered in quantity, again to strict specifications from the user.

•

With this procedure, the success of the final plastic component results from cooperation by both materials supplier and plastic processor, with neither shirking his responsibilities *under the watchful eye of the user.*

If each group can fulfill his responsibilities and functions under supervision, they should be able to police themselves. It is time the branches of the plastics industry stopped acting like irresponsible juveniles and become responsible adults.

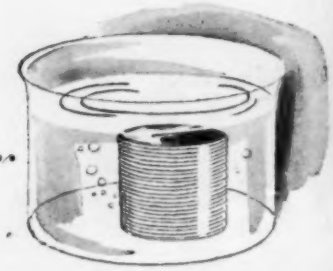
Arthur M. Merrill

Editor

News about

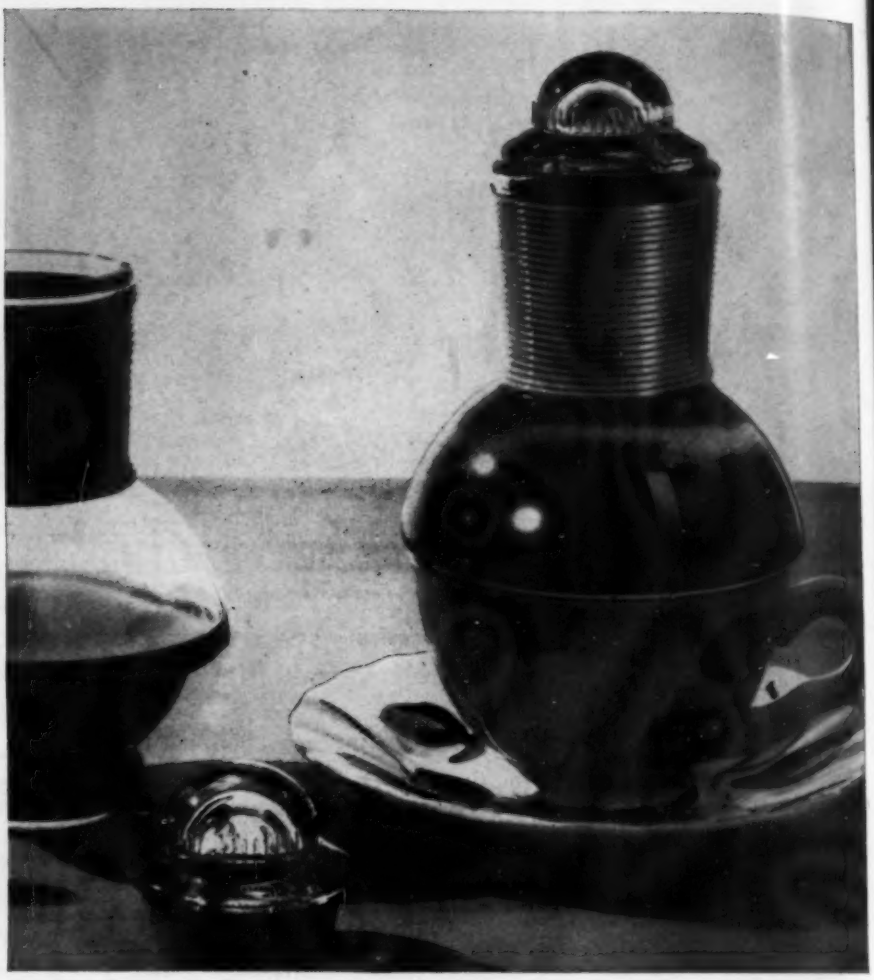
B.F.Goodrich Chemical *raw materials*

MOLD IT...



DUNK IT...

SHRINK IT...



Unique property of GEON plastics suggests new design applications

THE Geon vinyl plastic collar on this coffee server provides heat insulation and it's highly decorative in its six attractive colors. It is resistant to grease, detergents, acids and abrasion, and it comes through sterilization in autoclaves and dishwashers without damage.

1. **Collars mold accurately and retain their form, when made of Geon.**
2. **Dilated in an acetone solution, they can then be dropped over the neck of the bottle.**
3. **The acetone evaporates, causing the collar to shrink tightly in place.**

This new way to assemble Geon polyvinyl products has already suggested similar uses to other designers. One manufacturer slips protective sleeves on piping until refrigeration units are assembled. Another installs handles on his appliances by this dilate-and-shrink method.

For information on Geon, write Department DX-3, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

B.F.Goodrich

GEON polyvinyl materials • HYCAR American rubber and latex • GOOD-RITE chemicals and plasticizers • HARMON colors

Plastic Foams—Their Relationship and Competitive Picture

A realistic appraisal of the preparation, properties, advantages, and shortcomings of plastic foams in comparison with rubber latex foam

JOSEPH J. HIRSH, *Vice President—Engineering, Foam King, Inc., Bronx, N.Y.*

Joseph J. Hirsh was born in Canada, but received his formal education in New York City. After early work in sales, he has been engaged in various chemical research activities since 1943. From 1943-45, he was with Nu-Pet Products Co.; and worked in plastics research for T. M. H. Hall Co. from 1946-48. He founded and served as president of three companies: Shatterproof Corp. of America (1949-51); San-Jo Creations, Inc. (1950-51); and Grana-Flex Chemical Corp. (1952-53). He joined Foam King in April 1954, and has held his present position since November 1954.

Mr. Hirsh has been active since 1943 in private research work which has resulted in a complete line of therapeutic hair preparations, an anti-fungus preparation, and several medications for various types of dermatitis (these materials are now under clinical test); anti-static formulations for fabrics, plastics, etc.; a dip for synthetic yarns to prolong their service life; a new development in light-transmission dyes for the automotive glass industry; a new plastic coating for shatterproofing glass; several formulations for the automotive rebuilding industry; and developments in dehydrated foods.

Foam plastics are the newest materials of interest for today and tomorrow. Their introduction into industry and home uses promises a tremendous volume of sales. There are many types of new plastics formed into a soft, cellular structure by means of different processes, and all are claiming the future replacement of foam rubber.

Foam plastics, a generic group of lightweight cellular polymers or copolymers, can be used for many purposes. These applications include packagings of all types, cushioning, insulations, filters, construction purposes, flotation, marine products of all types, decorative purposes, toys, floats, crash pads, fishing floats, carpet underlays, balls, shoe soles, innersoles, clothing interlining, floor mats, acoustical purposes, and many others.

Mechanical properties are influenced by cell structure, foam density and choice of plasticizers. Chemical properties are influenced by the types of resin and plasticizers employed, percentage of plasticizers to resin, fillers, etc.

Comparison of Foams

There are many types of foams: those which can be prepared at room temperatures such as the urethanes; others which are made at atmospheric pressure either

Table 1. Comparison of Plastic Foams.

Foam	Type	Density Range, Lbs./Cu. Ft.	Cell Structure	Relative Cost	Properties	Applications
Cellulose acetate	Rigid; thermoplastic.	6.0-8.0	Unicellular	High	Good mechanical strength and temperature stability.	Insulation, flotation, structural.
Epoxy	Rigid; thermoset.	2.0-25.0	Unicellular	High	Good electrical properties. Difficult to process.	Radome fillers; electrical embedments. Foamed in place.
Polyurethane (Isocyanate)	Rigid or flexible; thermoset.	1.5-35.0	Unicellular and interconnecting	High	Good tensile strength and chemical and rot resistance. Poor light resistance. Poor formulation control. Toxic process.	Cushioning; padding; general replacement for foam rubber. Foamed in place.
Phenolic	Rigid; thermoset.	0.1-20.0	Unicellular and partly interconnecting	High	Very poor to very good mechanical strength. Good temperature stability.	Insulation; structural; radome fillers; packaging; oil evaporation covers. Foamed in place.
Polyethylene	Flexible; thermoplastic.	10.0-20.0	Unicellular	High	Good electrical properties.	Electrical wire coverings.
Polystyrene	Rigid; thermoplastic.	2.0-10.0	Unicellular	Low to moderate	Good moisture resistance. Poor thermal and chemical resistance.	Packaging; floatation; decoration.
Rubber (Latex)	Flexible; vulcanized.	2.0-25.0	Unicellular and interconnecting	Moderate to high	Poor tensile strength. Flammable. Very poor light and chemical resistance.	Cushioning; padding; mattresses; fillers; floatation; carpet underlays; shoe soles.
Silicone	Rigid or flexible; thermoset.	6.5-20.0	Unicellular	High	Good high temperature resistance.	High-temperature insulation.
Urea	Rigid; thermoset.	0.5-20.0	Unicellular	High	Poor mechanical strength.	Insulation; oil evaporation covers.
Vinyl	Rigid or flexible; thermoplastic and thermoset.	2.0-45.0	Unicellular and interconnecting	Moderate to high	Good tensile strength. Nonflammable. Good chemical and rot resistance. Excellent process and formulation control.	General replacement for foam rubber; floatation; cushioning; shoe soling; heat sealing; insulation; sponges; packaging; decorative; toys; crash padding; floor mats; acoustical.

in open or closed molds or on a conveyor belt, such as the vinyls and foam rubbers; and others which are made by the pressurized mold method, such as foam rubber and vinyl products.

Densities of various foams range anywhere from 0.1 to as high as 60 pounds per cubic foot. These can be expanded in situ, in molds or almost any shape, or can be made in sheets or slabs that are cut to the desired thicknesses at a later time. Some of the foams are thermosetting, while others are thermoplastic. The polymers now being foamed include urea, polystyrene, cellulose acetate, phenolic, epoxy, silicone, polyethylene, vinyl, and polyurethane, but it is not beyond the realm of possibility to foam practically any type of resin polymer or copolymer. Table 1 compares the different foams with respect to density range, cell structure, relative cost, properties, and applications.

Urea foam has very poor mechanical strength, but can be made in unusually low densities. Polystyrene foam has low density, exceptional moisture resistance, and good structural strength and low-temperature resistance, but is limited in use because of its destruction by too many acids, chemicals, and common reagents. Cellulose acetate foam is an extremely high-cost material.

Phenolic foam is a rather expensive finished product, and is handicapped by lack of experience. Silicone foams are good for use at high temperatures, but are rather expensive and involve a very lengthy process.

Rubber or Latex Foam

Foam rubber or foam latex can be compounded and foamed either mechanically (by whip and bowl or, more commonly, by the Oakes Frother) or chemically (by the use of hydrogen peroxide and activating substances whereby oxygen is related). In the Dunlop process, a mechanical frothing method, a gelling agent such as sodium silicofluoride is used. The liquid froth is poured into a metal mold or can be deposited on a conveyor

belt. Within several moments, the liquid foam gels into a solid foam and is cured at 212° F. The finished product must be washed and dried after curing.

In the chemical foaming method, such as the Talalay method, the latex mix containing the foaming agent is placed in a mold which is then closed. The mix foams in the mold and, when foaming is complete, is frozen and then gelled by carbon dioxide gas. The gelled foam is then cured, washed, and dried. This particular method is advantageous where it is important to have a product with complete breathing so that resiliency is at its highest (such as in throw pillows, cushioning, etc.). This method also provides for the possibility of producing finished molded products without upper and lower skins.

Polyurethane Foam

Polyurethane foams have also been described as polyester foams, polyester isocyanate foams, isocyanate foams, polyether foams, and polyester urethane foams. They are non-flammable and resistant to acids, alkalis, rot, mildew, oils, greases, and most common reagents. A great advantage of polyurethanes is their extremely light density and maintenance of high tensile and tear strengths. They will discolor, however, when exposed to ultra-violet light. They are of particular interest where foaming in place is necessary.

Production of polyurethane foam begins with a polyester resin and a di-isocyanate, plus certain water-bearing activating and processing materials which are intimately mixed. The di-isocyanate reacts with the hydrogen in the polyester and water to chain extend the polyester to form carbon dioxide. These reactions take place in just a matter of moments, particularly the reaction during which carbon dioxide is formed. As the molecules link up and form a network, the viscosity increases, the gas is retained in bubble form, and, in a few minutes, the foam becomes a solid. The reaction is exothermic so that elevated-temperature curing is not required; however, since the final setting and hardening normally takes several weeks at room temperature, a mild heat-treatment may be used to reduce this time and to further cure the exterior of the block which is not subjected to as high a reaction temperature as the center.

At present, the amount of waste in the manufacture of polyurethane foam is extremely high even after several years of experience in Germany. This scrap cannot be re-used in the process as can foam vinyl, which can either be returned to the process in the unfused stage or reground in the fused stage and used in extrusion. Special precautions are required by those who work with polyurethanes. If not carefully handled, the isocyanate can be particularly harmful to workers prone to bronchial catarrh, and protective spectacles, masks, and gloves must be worn. The polyurethane fumes given off during the exothermic part of the process are extremely toxic and gas masks or other precautions must be employed. Care must be taken to avoid inhaling the vapors released during the preparation of polyurethane foams.

At present, the process for making polyurethane foams is still far from being controlled. It is impossible, at this time, to produce foams of similar density and cell structure from batch to batch and from day to day. However, research continues and it is hoped that these disadvantages will be overcome in the future.

The development of the isocyanates took place in Germany before World War II, and production of this material continues there on a rather extensive basis. In this country, most of the raw materials for the polyurethane foams are manufactured by Mobay and Du Pont, both of whom hold various patents. Lockheed Aircraft Co. and several smaller companies also have patents on polyurethanes and claim processes of their own for the manufacture of polyurethane foams.

Polyurethane foams show particularly good promise owing to their high strength at low densities. However, they exhibit an unusual characteristic and different feel that has caused hesitancy in granting approval for this material for cushioning purposes. The outstanding characteristic of the foam is "bottoming," and results from a non-linear stress-strain curve which is in the shape of an ogive. The foam is resistant to slight pressures, but compresses deeply and suddenly to the bottoming point at higher pressures. Because of this unusual characteristic, in addition to the relatively low speed of recovery from distortion, polyurethane foams have a very different feel from other types of foams, such as foam rubber and foam vinyl.

Foams made from long-chain ether glycols have become available recently on a small scale, and show promise of overcoming the "bottoming" disadvantages. High load-carrying capacity at low density, very superior tensile strength, and solvent and oxidation resistance characteristics are indicated in this type of foam. The production of these ether glycol foams, however, is rather intricate and complicated, and the end-product is quite expensive.

There are two main types of polyurethane foams now in production; the rigid or semi-rigid insulation types, and the resilient cushioning types. These polyurethanes, which can be foamed in place or made in slab sheet stocks or in very simply designed molds, can be produced in a range of densities. The semi-rigid or rigid foams are mainly of the unicellular type, but cannot be considered as 100% closed cell foams; the resilient foams are all of inter-connecting cell structure.

Vinyl Foams

Vinyl foams have been made over a period of about 10 years. Early manufacture was only of unicellular structures made by the pressurized method. In the last few years, however, intensive research has been conducted in the manufacture of vinyl foams in open-cell types made at atmospheric pressure. Vinyl foams are highly plasticized and can be made in either open or closed cell structures. Interconnecting cells are produced atmospherically, while the unicellular types can be made by either pressurized methods or atmospherically; the latter is a recent development by Foam King, Inc.

There are two primary methods employed today in the manufacture of foam vinyls with inter-connecting cells: the mechanical method, such as the Elastomer (patented) and Dennis processes; and the chemical method (such as the Foam King process). The mechanical method provides a means of whipping into the plastisol an inert gas under pressure of approximately 100 psi. and upwards, while the mass is being agitated

and kept under controlled refrigeration. The prepared plastisol mix is placed in a pressure tank and kept at refrigerated temperature.

While the tank is rotating and the plastisol is being churned, the inert gas (such as nitrogen or carbon dioxide) is whipped into the plastisol through an opening in the side or bottom of the tank. The finished plastisol mix is then sprayed through a nozzle as a snowy foam, and this foam is then subjected to fusing temperatures. Vinyl foam made by this method must be fused almost immediately, otherwise the gas will escape and cause the collapse of the foam.

There are two general methods employed where chemical blowing agents are utilized to expand interconnecting-cell PVC compositions at atmospheric pressures.

One method employs an agent which does not decompose appreciably until fusion of the vinyl composition is fairly well advanced. Celogen, a blowing agent manufactured by Naugatuck Chemical, has been used satisfactorily in this method. In this process, decomposition of the blowing agent causes the bubbling or foaming of the molten, fluxed vinyl composition. This process is used only where thin layers of foam are required, and the high density obtained by this method is not objectionable. It is not possible to produce thick, highly-blown, lighter density sponge with this process.

The other method, such as the Foam King process, employs a prepared plastisol containing a chemical blowing agent, such as Du Pont's BL-353, which is poured into a mold, either open or closed, or deposited on a conveyor belt for a continuous sheeting operation. It is then subjected to lower temperatures (in the vicinity of 212° F.) where the blowing agent decomposes at a moderately rapid rate. This blowing temperature is below the plastisol gelation point, so that small gas pockets are formed which cause the mass to be foamed. The foam is then subjected to a fusing temperature of approximately 350° F. Figures 1-4 show manufacturing operations in the Foam King process.

Utilizing this method, the time required for the blowing stage, or decomposition of the blowing agent, is usually anywhere from 20-60 minutes. Fluxing or fusing usually takes from 20-60 minutes, depending on the foam thickness, density, cell size, and formulation. By the utilization of dielectric heat, this time can be reduced to minutes or even seconds. It is essential to use dielectric heat when sections of two inches or more in thickness are to be fused, but it is not necessary for thinner sections.

Contrasted to the mechanical method, the Foam King process obviates the need for pressurized tanks and/or refrigeration. Both foam density and cell structure are predetermined at all times. In addition, the extent of foam rise, whether in an open or closed mold, can be predicted at all times. Because of the simplicity of this method, a greater variation of formulations can be obtained than is possible with the mechanical foaming method.

Foams made by the Foam King method have high tensile and tear strengths, excellent resiliency and recovery, and completely uniform cell structure. Blow holes, such as are generally found in foam made by the other processes, are completely absent, and textures can be varied from superfine to extremely large cell sizes.

Molded products or slab forms made by the Foam King process can be stored in either unfused or unfluxed stages for long periods of time either at room, freezing, or elevated temperatures (up to 250° F.) without any visible change. The mass will take an unusual amount of abuse in its unfused stage without collapsing, a decided advantage over mechanically-blown foam.

The manufacture of unicellular foams generally takes place in pressurized molds where pressures of from 2-10,000 psi. are employed for a period ranging from 15 minutes and upwards in order to decompose the blowing agent and fuse the mass. After fusing, the molds are cooled and the foamed mass placed in hot water or in a heated chamber in order to complete the expansion by softening the mass so that the entrapped gas can expand the foam to its fullest capacity. A chemical blowing agent is employed in this process, such as Unicell N. D., Celogen, BL-353, etc. Rigid, semi-rigid, or resilient foams can be obtained at densities ranging from a minimum of 2½ pounds per cubic foot.

A new method for the manufacture of unicellular

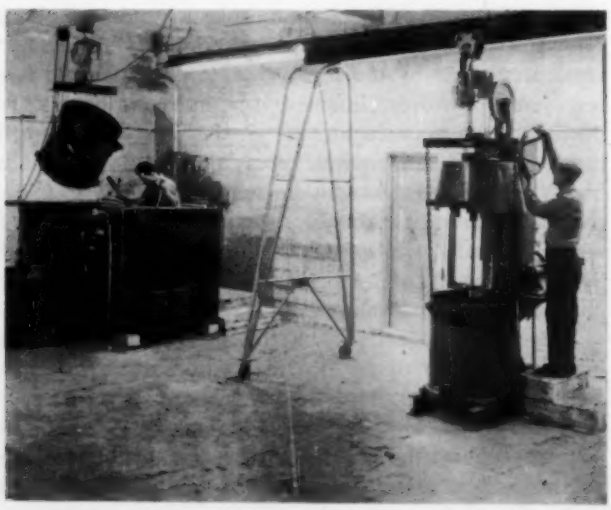


Fig. 1. Milling (left) and mixing (right) operations in preparing vinyl foam by the Foam King process

Fig. 2. Pouring Foam King vinyl foam mix into mold placed on weighing platform of scale.

foam has been developed recently by our company which permits the production of unicellular foam at atmospheric pressures without the utilization of pressurized molds, presses, etc. As a result, it is now possible to manufacture unicellular foam on a continuous sheeting basis in unlimited widths and in heights up to four inches, with the entire process carried out at atmospheric pressure. Densities up to 45 pounds per cubic foot are obtainable, with cell structures ranging from superfine to extremely large cell sizes. Because of the difference in manufacturing procedure, the foam obtained from this process has much higher tensile and tear strengths, better compression qualities, complete uniformity of cell structure, and low water absorption. Chemical qualities are similar to foams made in pressurized molds.

Dispersion-grade polyvinyl chloride resins are used most satisfactorily in the manufacture of vinyl foam. However, it is possible to incorporate copolymers such as vinyl chloride, vinyl acetate, vinylidene chloride, and vinyl chloride diethyl maleate, providing that these copolymers are used in concentrations not to exceed 15% of the total vinyl content.

The simplicity of the Foam King process results not only in an end-product of considerably lower cost, but also a fraction of the capital investment for equipment and the manufacturing space required for pressurized mold techniques.

Semi-rigid, rigid, and flexible unicellular foams made by this new method enjoy the unique quality of being nonshrinkable. Since pressurized-mold foams are expanded after decomposition of the chemical blowing agents and complete fusion of the plastic, they have a natural tendency to shrink back to their original size. On the other hand, foams made by the Foam King process are fully expanded before fusion has started, and have no tendency towards shrinkage.

The development of chemically-blown vinyl foam has been retarded by two major factors; lack of uniformity of end-products, and the length of time needed for decomposing the blowing agent. Product uniformity could not be obtained because of differences in PVC resins from one batch to another, even from the same supplier. The Foam King process overcame these differences by doctoring each resin batch to achieve uniformity. Our company's work has resulted in the development of two new PVC resin types which are designed specifically for foaming use. These new materials (which are covered by patent applications) will make it unnecessary to modify each resin shipment.

To reduce the time needed for decomposition of the chemical blowing agent, the Foam King process includes a method for accomplishing the complete foaming action (in heights up to four inches) in approximately 10% of the time previously required. We have recently developed foams, in both interconnecting and unicellular structures, in rigidities approaching that of stone.

The Competitive Picture

Needless to say, the foam rubber market stands to lose its leadership to some of these new plastic foams. In 1947, approximately 18,000,000-19,000,000 pounds of foam rubber articles were sold. In 1953, approximately 180,000,000 pounds of foam rubber products were sold, and it is predicted that the total sales volume for all types of foams may well be over 500,000,000 pounds annually by 1960.

The race to control the foam market is being shared by foam vinyls, polyurethane foams, and, of course, foam rubber. There appears to be little doubt that either the foam vinyls or polyurethanes, or perhaps both, will almost completely replace foam rubber because of the latter's many undesirable features. For example, foam rubber is highly inflammable; will create and retain static electricity; and is hygroscopic, therefore its odor is discernible during humid days. Foam rubber will rot and deteriorate from cleaning fluids, oils, greases, and many chemicals found both in the home and in industry. It has poor tensile and tear strengths, and suffers when exposed to the elements. These shortcomings have been known for some time and the rubber industry has been busily engaged in a search for a new material to replace foam rubber.

Both vinyl and polyurethane foams are logical materials at this time to replace foam rubber because they have all of the advantages of foam rubber without any

(*Continued on page 389*)

Fig. 3. Removing finished sheet slab of Foam King vinyl foam from mold after fusion.

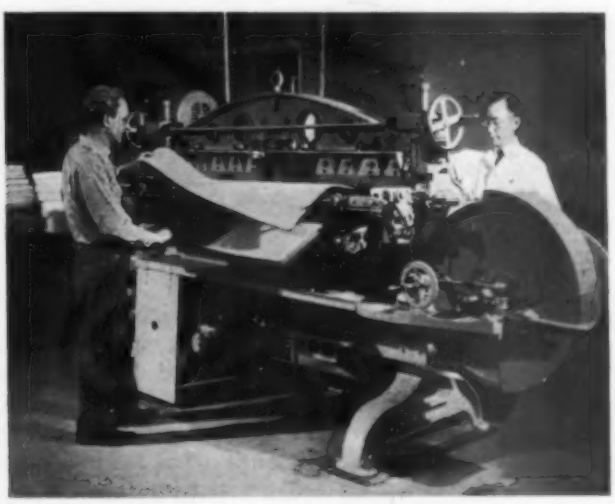


Fig. 4. Splitting thinner sheets from a finished thick slab of Foam King vinyl foam.

L. W. A. Meyer

R. J. Scogin

Properties and Applications of Butyrate Pipe*

A discussion of the composition, properties, creep data, fittings, fabrication, installation, and applications of the pipe.

L. W. A. MEYER, *Supt. of Tenite Development Dept. and Asst. Supt. of Tenite Division,*
and
R. J. SCOGIN, *Chemical Engineer,*
Tenite Development Dept.,
Tennessee Eastman Co., Division of Eastman Kodak Co.
Kingsport, Tenn.

Pipe extruded from cellulose acetate butyrate plastic has been used successfully for various industrial and chemical applications for 11 years. Pipe made from this material is a natural choice for many industrial applications because of its toughness, light weight, ease of fabrication and installation, and resistance to conditions encountered in oil and gas fields and similar environments.

A considerable quantity of pipe extruded from butyrate plastic has been used successfully for natural gas service lines and in the oil fields for transporting salt water and sour crude oil. Although a few failures have been reported in the oil fields, investigation has indicated that most of these may have been caused by too high temperatures and/or pressures. In a few cases, the plastic extrusion material may have been contaminated or the pipe may not have been extruded under optimum conditions.

Carbon black pigment is generally known to be an excellent filter for ultra-violet rays from the sun. The test results, confirmed by the results of commercial testing laboratories, show that black butyrate pipe made with carbon black pigment has excellent resistance to continuous outdoor exposure. For outdoor and indoor installations where observation of the flow of material is desired, pipe extruded from clear butyrate containing an ultra-violet inhibitor may be employed.

*Based on a paper presented at the twelfth annual National Technical Conference, Society of Plastics Engineers, Inc., Cleveland, O., Jan. 19, 1956.

Table 1. Properties of Tenite Butyrate Pipe Molding Compositions.

	Test Conditions			Tenite Butyrates	
	Temp., °F.	R.H., %	ASTM Method	460-E MH	265-E MH
Flow temperature, °F.	—	—	D569-48, Method A	302	302
Specific gravity	73.4	50	D792-50	1.20	1.19
Hardness, Rockwell "R"	73.4	50	D785-51, Method A	104	97
				2.1	2.4
Izod impact strength, ft.-lbs./inch of notch	—40	—	D256-54T, Method A	0.9	0.9
	73.4	50		2.1	2.4
Tensile strength at fracture, psi.	73.4	50	D638-52T	5,550	5,000
	158	—		2,800	3,300
At upper yield, psi.	73.4	50	D638-52T	4,300	3,800
Elongation, %	73.4	50	D638-52T	54	61
Flexural strength at yield, psi.	73.4	50	D790-49T	6,200	5,750
Compressive strength at yield, psi.	73.4	50	D695-54	6,300	5,700
Modulus of elasticity in flexure, psi. x 10^5	73.4	50	D747-50	1.35	1.20
Distortion under heat, °F.:					
At 264 psi. load	—	—	D648-45T	152	146
At 66 psi. load	—	—	D648-45T	176	171
Deformation under 2,000 psi. load, dry, %	122	—	D621-51, Method A	7	10
Water absorption after 24 hrs. immersion, %:					
Total	73.4	—	D570-54T	1.6	1.4
Soluble matter lost	73.4	—	D570-54T	0.1	0.1
Weight loss after 72 hrs. accelerated aging, %	180	—	D707-51T	0.7	0.5

Butyrate pipe is extruded commercially on conventional extrusion machines in IPS (iron pipe size) and SWP (solvent-welded pipe) nominal sizes up to six inches. Fittings such as couplings, elbows, and tees can be injection molded or fabricated.

This presentation includes descriptions of the chemical composition of butyrate molding materials; the physical and chemical properties of Tenite Butyrate plastic for pipe; creep test data on pipe extruded from Tenite Butyrate; fittings, fabrication, and installation techniques; and successful industrial applications.

Chemical Composition

Butyrate plastic molding compositions for pipe are made from cellulose acetate butyrate esters, plasticizers, pigments, and dyes. Cellulose acetate butyrate is made by esterifying alpha-cellulose with acetic and butyric acids and anhydrides in the presence of a catalyst, such as sulphuric acid. The esterification is carried almost to the triester stage, and then the product is hydrolyzed to an acetyl content of approximately 12% and a butyryl content of approximately 37%.

The molecular weight of the cellulose ester is controlled so that the viscosity of a 20% by weight solution of the ester in acetone is in the range of 8,000-12,000 centipoises. High-boiling organic esters are used as plasticizers. Pigments and dyes give desired translucency and color. The amount of each ingredient used is in accordance with the properties desired in the final product.

Properties

The physical properties of Tenite Butyrate formulas 460E-MH and 265E-MH, suggested for use in pipe, are shown in Table 1. Butyrate pipe is generally extruded from MH flow material. The data presented represent average values.

The permeability of butyrate pipe to water is low, and weeping has not been observed in any installations. Butyrate pipe has good resistance to aliphatic hydrocarbons, sour crude oil, salt solutions, natural gas, dilute acids and bases, corrosive earth, and electrolytic action. It is not recommended, however, for use with strong acids or bases, or with organic solvents in general. It is often practical to use the pipe in certain environments even though the inside surface may be attacked to some degree.

Creep Test Data

There has been considerable need for data on creep under internal pressure of plastic pipe used in the gas and oil industries, and for other structural installations. Long-term creep tests on butyrate pipe under internal water pressure were begun about 18 months ago by Tennessee Eastman, and an interim report was issued on January 20, 1955 (1, 2).** It is hoped that the creep data obtained to date from these continuing tests will prove useful as a guide for the design of service installations to employ butyrate pipe, pending completion of the tests and publication of the final results.

** Numbers in parentheses refer to bibliography at end of article.

Nine-foot lengths of four different sizes of pipe were used in the tests. The four different sizes of butyrate pipe which are being evaluated by long-term creep, along with the dimensions of each, are shown in Table 2.

Table 2. Sizes and Dimensions of Tenite Butyrate Pipe Test Specimens.

Nominal Size, In.	Pipe Type	Dimensions, Inches		
		O.D.	I.D.	Wall Thickness
2	SWP	2.250	2.000	0.125
2	IPS	2.375	2.067	0.154
3	IPS	3.500	3.068	0.216
4	*	4.500	4.000	0.250

* O.D. same as for IPS, but wall thickness was 0.013-inch greater.

These pipe specimens were mounted on racks, filled with water, and maintained under different internal pressures. A photo of a test rack is shown in Figure 1. The outside diameters of the pipes were measured periodically, and the percentage increase in outside diameter for each of the different sizes of pipe was plotted against time to obtain the curves shown in Figures 2-5. Internal pressures and hoop stress data (unit fiber stress) for each pipe size are indicated on each figure.

The hoop stresses were calculated from Barlow's formula:

$$S = \frac{P \times O.D.}{2T}$$

where S = hoop stress, psi.
P = internal pressure, psi.
O.D. = outside diameter, inches.
T = wall thickness, inches.

Each of the four sizes of pipe was tested wet in two different formulas at two different temperatures and five different pressures. Four test groups, with each group comprising all four sizes of pipe, were arranged as shown in Table 3.

Table 3. Test Grouping of Tenite Butyrate Pipe.

Group	Formula	Test Temp., °F.
(1)	435-22300-MH Clear*	Room
(2)	265E-20337-MH Black	Room
(3)	435E-22300-MH Clear	120
(4)	265E-20337-MH Black	120

* Formula 460 is now being suggested for extruding clear pipe since it contains an improved ultra-violet inhibitor.

The test pieces were supported horizontally on standard pipe hangers spaced at about four-foot intervals. The ends of the pipe were free, not rigidly held in compression or tension. The water was held in the pipes by mechanically sealing the ends.

The percentage increase in O.D. was plotted against time for each pipe in each group. The test pipes for formulas 435E-MH clear and 265E-MH black were subjected to five different internal pressures ranging from 50-200 psi. for periods up to 560 days. The room temperature was not controlled and ranged from about 70-100° F., with an average temperature of about 80° F. The pipe specimens of these same two formulas were subjected to five different internal pressures ranging from 80-120 psi. for periods of up to 320 days at a controlled temperature of 120° F.

Fig. 1. Butyrate pipe on test rack to determine creep under various internal pressures.

A typical creep curve for the two-inch IPS pipe (formula 265E-20337-MH black) tested at 120° F. is shown in Figure 2. The five different internal pressures ranged from 80-120 psi. with corresponding hoop stresses of 625-920 psi.

It is characteristic of butyrate pipe that some creep occurs, even at normal temperatures and at pressures as low as 50 psi. The creep usually continues gradually and, when plotted on a semi-logarithmic scale, approximate a straight line.

Summary graphs for each formula at each of the two temperature conditions represent the highest safe hoop stress values obtained for each size of pipe tested. A safe hoop stress range of 700-740 psi. is shown in Figure 3, which presents the summary graph for formula 265E-MH black tested at 120° F.

The safe hoop stress ranges from each summary graph are given in Table 4. From these data, hoop stress was plotted against temperature (see Figure 4). This graph can be used for calculating the safe working pressure for a given pipe size, or the pipe dimensions necessary to withstand a given internal pressure.

Figure 5 shows creep data on a 10-foot length of butyrate pipe (4.5-inch O.D.; 0.250-in. wall) which has been in continuous outside service for 5½ years on a 95-105 psi. water line carrying a low flow. The air temperature range is about 20-100° F., and water temperature range about 35-95° F. The pipe was extruded from formula 205E-22300-MH clear. The highest hoop stress to which this pipe is subjected is 945 psi., and the tensile strength of the material is 4,680 psi. at 100° F. The O.D. has increased about 4% and has been relatively constant since the first 16-20 weeks, indicating that continued satisfactory service may be expected.

In planning service installations, it is suggested that

Table 4. Summary of Safe Hoop Stress Values for Tenite Butyrate Pipe in Each Test Group

Formula	Hoop Stress, psi.*	Test Temp., °F.	Tensile Strength at Fracture, psi.
435E-22300-MH Clear	1,010-1,180	Room**	4,680##
265E-20337-MH Black	810-1,015	Room**	4,460##
435E-22300-MH Clear	740-850	120	4,020
265E-20337-MH Black	700-740	120	4,060

* Highest considered safe from these tests.
** Range, 70-100° F.; average, 80° F.
# ASTM D638-52T test method, conditioned by ASTM D618-51T Procedure A.
At 100° F.

consideration be given to the safe hoop stress values shown in Table 4 and, especially, to Figure 4 in which hoop stress is plotted against temperature. These hoop stress values represent from 17-20% of the short-time tensile strength at fracture.

Previous estimated safe working pressures for pipe extruded from butyrate have been calculated on an arbitrary basis of 20% of tensile strength. A considerable quantity of butyrate pipe has been installed on the basis of this guide and, in general, has proved satisfactory. The data in this paper roughly confirms these previous assumptions.

The previously described tests were run at a constant pressure, and were not subjected to impact loading caused by water hammer or external force. There is a definite need for control tests on plastic pipes to insure use of only top-quality pipe in commercial installations. Various committees in SPI and ASTM are working on standards, dimensions, tolerances, and control tests on physical properties of extruded pipe.

Fittings, Fabrication, Installation

Butyrate fittings, such as couplings, elbows, and tees, usually are made by injection molding. They also can be fabricated by sealing together pre-set sections by use of a solvent and cement.

Butyrate pipe can be connected to metal pipe by means of compression fittings with a metal insert inside the plastic pipe, or by O-ring type plastic metal adapters. The latter, along with molded butyrate elbows and a tee, are shown in Figure 6. Van Stone flanges and bell couplings can be made easily by heating the pipe end in hot oil and forming it on a metal die. The Van Stone flange assembly also provides an easy way to connect butyrate pipe to existing metal pipe or valves. Butyrate pipe can

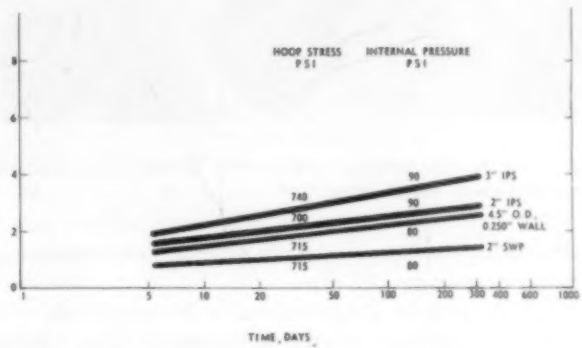


Fig. 3. Summary of creep data on butyrate pipe (wet) at 120° F. and various internal pressures.

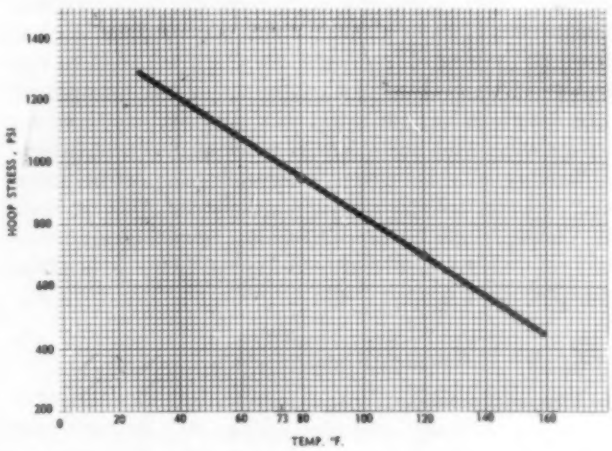


Fig. 4. Effect of temperature on safe hoop stress for butyrate pipe, based on long-term creep tests.

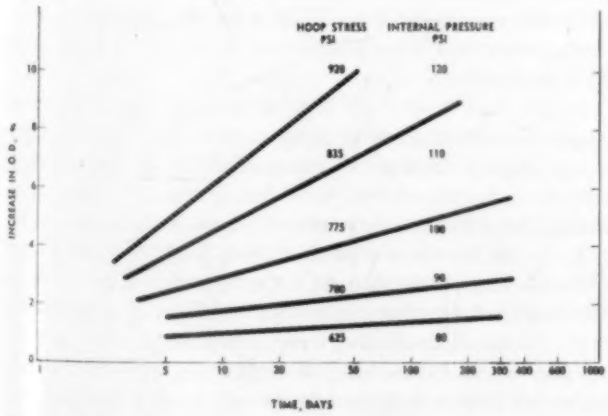


Fig. 2. Creep of 2-inch IPS butyrate pipe (wet) at 120°F. and various internal pressures.

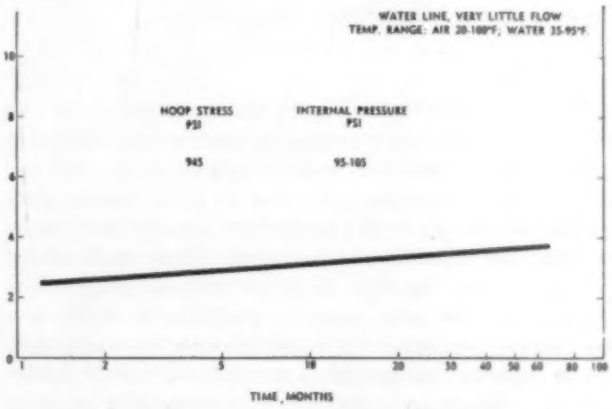


Fig. 5. Creep of butyrate pipe (wet) in outside service. Pipe, 4.5-in. O.D. and 0.250-in. wall, was used as a 95-105 psi. water line.

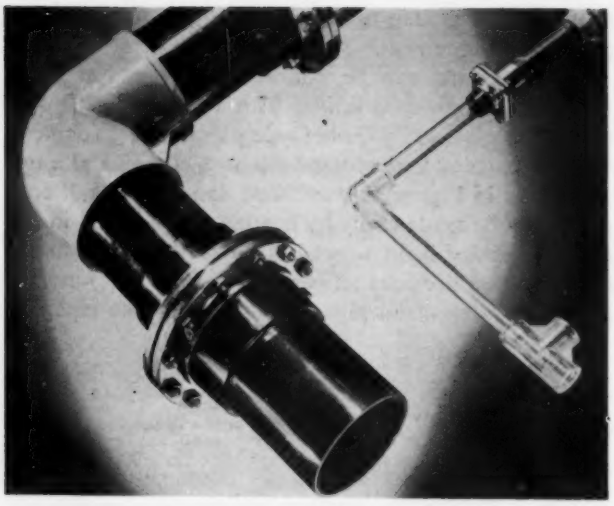


Fig. 6. O-ring type adapters and molded fittings for connecting butyrate pipe to metal pipe.

be threaded, but threading is not generally recommended because it weakens the pipe.

Rapid joining of butyrate pipe is accomplished with slip-sleeve couplings, solvent, and cement. The solvent and cement are applied to the end of the pipe and to the inside of the coupling. The joint is made by inserting the end of the pipe in the coupling, and twisting it about one-half turn. In field installations, the pipe is joined beside the ditch, then the continuous length is easily lowered into the ditch by one man. A crew of three men can lay about 4,000 feet of four-inch butyrate pipe in one day. It is recommended that pipe hangers be placed at four- or five-foot intervals in overhead installations.

Bends up to 90° can be formed in a jig of the proper radius while heating the pipe about 250° F. The inside of the pipe may be supported either by inserting a rubber tube in the pipe and inflating the tube, or by filling the pipe with sand.

Industrial Applications

The light weight of butyrate pipe simplifies the transportation problems, and pipe lengths may be distributed along the ditch by light truck or wagon. One man can lift and carry three 20-foot lengths of four-inch butyrate pipe, which weighs only about one-twelfth as much as cement-lined steel pipe. Butyrate pipe may be cut easily on the job with an ordinary handsaw.

Oil Fields

Butyrate pipe has met with wide acceptance in the petroleum industry for combating corrosion. It has been used in contact with salt water, crude oil, sour crude oil, natural gas, corrosive earth, and in places where electrolytic action has been a major problem. In these cases, no apparent corrosion has occurred. These applications include ground lead lines in low-pressure or gravity-flow systems, piping from producing wells to the separation system, and piping for salt water from the receiving tank to the collection pit and on to the disposal well. Butyrate pipe has about the same frictional resistance as glass pipe; consequently, it is often possible to use smaller lines than would be required by similar flow requirements for steel pipe.

Butyrate pipe resists the accumulation of paraffin in oil flow lines. Examination of the interior of a section of butyrate pipe in a crude oil line showed that practically no paraffin had been deposited after several months' use. Metal pipe used in similar installations is often rendered useless in a short time because of paraffin deposits on the walls.

Gas Industry

Butyrate pipe has been used successfully by the natural gas industry in increasing quantities since 1945 as service lines and, more recently, as mains. The ability of butyrate pipe to be coiled reduces installation expense since fewer connections are required, and the coils are easy to transport and handle. In service renewal lines, butyrate pipe from a coil often can be inserted in an existing line, thus avoiding the necessity of disturbing the intervening areas such as lawns, sidewalks, and streets.

A service saddle is used to join a butyrate service line to the butyrate main. The saddle is joined to the main by means of solvent and cement, and held in place for a few minutes with a metal clamp. The saddle has a built-in drill bit which provides a means of drilling through the butyrate main. Butyrate pipe which had been in continuous use in gas service lines for eight years was found to be strong as new tubing.

Irrigation and Sprinklers

Transparent thin-walled butyrate pipe has been used extensively as siphon tubes in irrigation. In this application, flow can be seen, and air locks and dirt can be detected readily.

More than five miles of butyrate has been installed in a sprinkler system to expand a slash pine seedling nursery in Florida. The reticulation system has laterals 520 feet long. The butyrate line was easily lowered into the ditch after risers of galvanized metal had been screwed into the threaded adapters of the tee joints. Rotating sprinkler heads were then mounted atop the risers.

Some 90,000 feet of butyrate pipe has been installed in the grounds of a new state hospital in California. This plastic sprinkler system is believed to be one of the largest in the West. Pipe sizes used ranged from three inches for the sprinkler lines, to ¾-inch for the smallest feed lines. The pipe is flexible enough to follow the ditch contour in most instances without use of angle couplings. Because the soil is very corrosive, metal parts were kept to a minimum.

More than 5,000,000 feet of butyrate pipe are now in use in Australia carrying water to hot, drought-ridden acres. Highly resistant to the corrosive soil, these butyrate lines long outwear metal lines, which in the same installations have to be replaced about once a year.

Coils of butyrate pipe 300 feet long, but weighing only 40-50 pounds, can be transported readily to even the remote Australian "outback" by plane, car, or horseback. Ground conditions in many regions permit pipe to be laid without trenching. In this case, one end of an unwound coil is attached to the shaft of a mole plow set for the desired depth. The moving plow then lays and covers the pipe in one operation, in either a straight

or curved line. As much as 600 feet of one-inch pipe has been installed in this manner in a single run. One large citrus orchard development has a total pipe length of 250,000 feet in use.

Machinery is available now in the United States for laying plastic pipe (from a coil) just under the surface of the ground at golf courses and lawns with little disturbance of the turf.

Electrical Conduit

In a more recent and highly promising application, butyrate pipe is being used as electrical conduit for telephone and power cables. Tennessee Eastman is using it extensively for this purpose, and an 8,000-foot installation has been completed recently by a utility company. Butyrate pipe can be covered with concrete, or subjected to normal backfilling operations. The pipe will conform easily to long-radius bends, and preformed 45° or 90° bends are used as required by service conditions.

At the mid-point of a multiple-conduit line between an electrical manhole and a substation cable vault in an installation at Tennessee Eastman, vertical pairs of conduit make a transitional curve which brings them to a cable vault in a horizontal spread. Since the pipe is semi-flexible, no special fittings are required for this transition. Butyrate flanges are used on the ends of conduits terminating in a wall or floor, providing a smooth surface over which cable may be pulled. The flanges are used effectively, for example, where the cable enters or leaves a manhole or cable vault, and concrete may be set flush around them. The extruded butyrate pipe or coupling can be swaged with heat to fit over the end of existing metal pipe to which the butyrate conduit is connected.

Lining for Metal Pipe

Thin-walled butyrate pipe may be used for lining iron pipe when corrosion resistance and greater strength are needed. The pipe may be inserted in new lines or in existing lines which have failed because of corrosion. First, the inside walls of the metal pipes are scraped and blown out to remove burrs and foreign matter. Then, standard 20-foot lengths of butyrate liner joined with either internal or external solvent-welded sleeves are pulled through the metal pipe for a distance of 400-600 feet. The butyrate liner can be expanded to conform to the inside wall of the metal pipe so that the strength of the metal pipe can be utilized. This expansion can be accomplished with water, low-pressure steam, or the fluid being pumped.

In an experiment, a three-inch butyrate liner was inserted in a 20-foot length of three-inch iron pipe, and an O-ring type of plug was used at each end to prevent leaks. Internal water pressure of about 1,200 psi. was maintained for eight hours each day for 6 days at 40-60° F. Twice during this test, the pressure was released and water at about 115° F. was run through the pipe for one hour before the pressure was reapplied. At the completion of the test, there was no evidence of leakage or failure of either the O-ring plugs or the butyrate liner. In fact, the liner expanded against the inside of the iron pipe so tightly that a chain hoist was needed to remove it

Other Applications

Butyrate pipe is being used to transfer an iron oxide and water slurry to a polishing machine in a glass plant. This pipe has been in successful use for seven months as a test installation, and plans are under way to replace the present red brass line with butyrate pipe.

Bagasse waste water, which results from the processing of sisal leaves for fiber and is highly acidic, is carried from the decorticator through a four-inch butyrate pipe for 1,500 feet to a disposal pit. This pipe is reported to be the only material used in years for this disposal operation that has not shown quick signs of deterioration.

Dixie paper cups are blown for several hundred feet from the manufacturing area of the plant to the packing and shipping area through transparent butyrate pipe. This labor-saving device carries the cups overhead, out of the way of other plant operations.

A two-inch butyrate pipe has been in constant use for the past 11 years carrying wine from storage tanks to the bottling room. Millions of gallons of wine have been pumped through the lines with no apparent damaging effects.

Approximately 20,000 feet of butyrate pipe in diameters up to six inches have been installed in various types of service at Tennessee Eastman. The majority of these have been in constant use for periods up to 5 years. Most of the installations were made to replace more expensive materials such as stainless steel; however, some were for test installations. Clear pipe was selected in most of the operating areas, since it was advantageous to see the flow of material. The installations include lines for transfer of acetic acid and water slurries, wash-water, demineralized water, waste chemicals, and brine; sight glasses on tanks; pneumatic conveyor systems; and electrical conduit. Most of these installations have been entirely satisfactory, and the few failures which have occurred are believed to have been caused by faulty installation or excessive pressure and/or temperature.

Summary and Conclusions

Butyrate molding compositions for pipe are made from cellulose acetate butyrate esters, plasticizers, pigments, and dyes. The amount used of each ingredient is dependent upon the properties desired in the final product. Properties which promote the use of butyrate pipe in industrial applications include toughness, light weight, ease of installation, and resistance to corrosive conditions in the oil fields, natural gas lines, and similar environments.

The long-term test program to obtain data on creep and other engineering properties of butyrate pipe is continuing. Creep data obtained to date show that safe hoop stress values for butyrate pipe are about 700 psi. at 120° F., and 950 psi. at 80° F. This information should be valuable in designing service installations employing butyrate pipe.

Butyrate pipe is easily joined by use of solvent and cement. Fittings such as elbows and tees can be injection molded or fabricated. Connections can be made to metal pipe with compression-type metal fittings having a metal insert inside the plastic pipe. O-ring types of

(Continued on page 402)

Willard Stewart, Inc.

Guest Editorial

Hi-fax, a New Ethylene Polymer

ELMER HINNER, *General Manager,*
Cellulose Products Dept.,
Hercules Powder Co.,
Wilmington, Del.

The many inquiries which we have received since Hercules first announced plans to produce low-pressure polyethylene indicate that there is much general interest on the part of processors and consumers alike in this new-type plastic. I am pleased, therefore, to have this opportunity to discuss our new product. Perhaps a brief description of this new material, pointing to some of its unusual properties, will permit you to properly judge the impact it can be expected to make on the appearance and function of future products made with plastics.

I like to refer to our new Hercules product, which we have named Hi-fax, as an ethylene polymer, rather than as a different type of polyethylene. Comparisons, with conventional polyethylene are unavoidable, however, and the new material is most readily understood in terms of its relationship to its older brother.

Chemically, Hi-fax is a polymer whose building block, the ethylene unit, is identical with that of conventional, relatively soft polyethylene. Ordinary polyethylene is prepared under very high pressures with peroxide catalysts in a free-radical type of polymerization. By this mechanism, in which 500-1,000 individual monomer units combine under normal conditions to form polymer molecules, a considerable number of "faults" occur in the chain structure of the polymer. Instead of getting one single long chain as a molecule, branches occur—some relatively short, and some many monomer units long. These branches have a profound effect on the final properties of the polymer. In addition, with this method of polymerization there seems to be a definite upper limit to the number of ethylene units which can be put into a polymer molecule; this, too, places limitations upon the product properties. In general, the longer the chains the tougher and stronger the polymer becomes.

With the new type of polyethylene, the monomer units build up into polymer chains by an entirely different mechanism. Catalyst materials are quite different, and the polymerization occurs readily at ordinary pressures. The polymer chains, while not entirely free of faults, are much more nearly linear than those in the ordinary polyethylene; and the number of ethylene units going into a polymer can be raised to almost any desired level. Materials containing on the average more than 35,000 such monomer units have been made in the laboratory; a degree of polymerization far beyond that necessary to attain the desired strength properties.

The greater linearity in the molecules of the new-type polyethylene has several effects on the properties of the polymer. For one thing, this greater regularity permits a chain to line itself up more perfectly with its neighbors, so that the crystallinity and density are higher than with ordinary polyethylene.

The polymer is stiffer and harder and has a surface of good gloss, unlike the dull polyethylene to which we have long been accustomed. It is much more resistant to heat, such as in resisting distortion in boiling water. It is less permeable to the passage of fluids such as gases or oils. The material is resistant to many chemicals and to most solvents. Its tensile strength is much greater than that of ordinary polyethylene; in fact, this crystalline polymer can give tensile strengths in the order of 60,000 psi. or even higher, which is in the range of mild steel.

The plastics industry is expanding rapidly, and new uses are being developed continually. In many instances, the new uses are very close to or even a little beyond the limiting ability of the plastic being employed to do the best possible job. Hi-fax is expected to enter the general field of injection molding and extrusion, offering improvements in the quality of many items now being made of other plastics. It should also open the door to a whole new group of plastics applications in areas where previously available materials have not been able to fill the bill.

In the field of injection molding, the general area of "housewares" perhaps represents the largest potential market for Hi-fax. Mixing bowls, canisters, cups, waste baskets, and sink strainers are a few of the miscellaneous household items which may be made of Hi-fax. The fact that the plastic is not affected by boiling water should prove important here and also in laboratory and hospital supplies. Various industrial moldings, electrical coil forms, radio and television parts, molded containers, and toys (one of the plastics industry's favorite products) all present possibilities utilizing the strength and durability of Hi-fax.

Hi-fax may be extruded to form foil, sheeting, wire and cable coatings, pipe, or even quite small-diameter monofilaments or multifilaments. Although much harder than conventional polyethylene, Hi-fax is quite flexible in thin sections. Blow molding can be employed to form bottles or other hollow objects made of Hi-fax which can be heat-sterilized.

In all of the fields where Hi-fax has been evaluated, the results have been up to our full expectations, and the enthusiasm of users beyond anything we might have hoped for. There are, of course, the same problems of mold design and construction, molding techniques, and part design with Hi-fax as might be expected with any new and unfamiliar plastic material. In this regard, we are confident that Hercules' background in the plastics business will be of great value in introducing, servicing, and developing uses for this unique new material.

—THE END

Plastic Foams—Their Relationship and Competitive Picture

(*Continued from page 381*)

of its disadvantages. Foam vinyl, for example, is non-flammable; non-hygroscopic; and resistant to rot, mildew, oils, greases, alkalis, acids, and most common reagents. When properly formulated, it is not affected by ultra-violet light or the elements in general; will not dry out, crack, or craze; and most important of all, is competitive in price with foam rubber.

Looking at the situation realistically, it would appear that foam rubbers are steadily losing ground but will probably always enjoy a small percentage of the foam market. Polyurethane foams, if and when fully developed to a controlled process, will undoubtedly enjoy a substantial portion of the cushioning market, but that day is not yet in sight.

To date, too many confusing statements have been projected to mislead both the scientist and the layman as to the present status of polyurethane foams. For example, a claim that these foams are equal in price to that of foam rubber has never been substantiated. Actually, in yardage or on a cubic-foot basis, it is true that polyurethane foams can be comparable in price to foam rubber, but only when a polyurethane foam of a 1½-2 pound density is compared to an 8-10 pound density in foam rubber. The point obviously omitted, however, is that this lower density foam cannot meet the same physical characteristics as the 8-10 pound density in the foam rubber; at least a 5-6 pound density polyurethane foam would be necessary to achieve the same results, in which case it would then be several times the price of foam rubber.

At present, it would seem that foam vinyl stands to become the leader in the foam industry and maintain that leadership for some years to come. This prediction is based on the simplicity of manufacture, the recoverability of scrap, the low cost of manufacturing and handling, the extremely low dollar investment for dollar production, and the all-around good characteristics of foam vinyls.

Bibliography

(1) Carr, J. A., and Williams, B. B., "Flexible Foams—Past and Future," **Modern Plastics**, 33, 1, 114 (Sept. 1955).

(2) Katz, Irving, "The Isocyanate-Base Polymers," **Materials & Methods**, 42, 2, 84 (Aug. 1955).

(3) Raskin, Betty Lou, "Foamed Plastics—A New Field of Chemistry." Paper #30 in "Papers Presented at the Minneapolis Meeting," Division of Paint, Plastics and Printing Ink Chemistry, American Chemical Society, 15, 2, 296 (Sept. 1955).

—THE END

Causes of Fish-Eyes in Vinyl Articles

Causative factors behind the formation of fish-eyes or gels in vinyl surfaces, and the role played by plasticizer absorption of the resin.

MARION R. RECTOR, *Group Leader,*
Saran Polymerization Laboratory,
Dow Chemical Company,
Midland, Mich.

In the fabrication of articles from polyvinyl chloride, surface irregularities are encountered which are frequently termed fish-eyes or gels. Fish-eyes not only present fabrication difficulties, but they can also be focal points for degradation. Furthermore, finished articles have an esthetic disadvantage if they have surface blemishes or "windows." Both in theory and practice, fish-eyes can be traced, in part, to the resin, so that PVC production and research are much concerned.

To arrive at some common definition of the irregularities being discussed, we can define a fish-eye as a localized inhomogeneity which differs from the surrounding continuous medium particularly in flow viscosity, and which is generally observed as a localized surface malformation. Fish-eyes also may be recognized as transparencies in pigmented film or sheet. If the fish-eye results from a spherical particle, the malformation will tend toward an hemispherical appearance, whereas other shapes produce irregular elevations of the surface.

It is recognized that foreign particles such as lint, dirt, and most anything with a melting point greater than that of the fabrication temperature can cause surface imperfections. Although freedom from this sort of thing is essential throughout production and fabrication processes, this discussion will be limited to resin-related fish-eyes.

Effect of Flow Characteristics

As previously indicated, fish-eyes result when individual particles differ primarily in flow characteristics under the conditions of fabrication. Several factors which could cause individual particles to differ are cross-linking, variations in concentration of plasticizing materials, molecular weight, and compositional contamination. By

far the majority of resin-caused fish-eyes appear to be due to the extreme variation in flow viscosity resulting from under-plasticization.

If each and every particle in a formulation is equally plasticized, there should not be any fish-eye trouble. However, if a low percentage of resin particles are under-plasticized, there is insufficient shear either by the main molten mass or by the fabrication equipment to render the particles homogeneous within the mass. These particles do not conform as readily to film or fabricated article surface, and presumably make matters worse by exhibiting elastic memory. Causes for plasticizer variations will be indicated in this discussion.

Figure 1 indicates the extreme range of flow which individual particles may exhibit depending upon the degree of plasticization. The curve is from data based on Dow PVC 111, as determined on a Tinius-Olsen flow tester at 180° C. and 740 pounds pressure. Of course, other conditions of temperature and pressure will alter this range. The separate points (shown by X's in Figure 1) indicate the flow at comparable plasticization of the higher molecular weight Dow PVC 100. These data indicate both the effect of partially-plasticized material of the same molecular weight, and of plasticized material of higher molecular weight. Both conditions are known to produce fish-eyes.

It may be inferred that the shear force of a fluid mass on an individual particle of high flow resistance appears to be relatively low during most fabrication operations. Thus, the individual particle does not truly become a part of the fused system. These individual particles are emphasized by their resistance to "draw-down" or "necking" when extruded products such as film or monofilament are made. These same particles show an elastic memory characteristic in the surface of calendered and extruded articles.

If we were to reconstruct Figure 1 in such a fashion as to relate temperature to percent dioctyl phthalate content to obtain equivalent flow, it could be readily seen that low plasticization requires very high temperatures for equivalent flow. It is generally recognized that polymers must achieve sufficient melting to cause enough stress relaxation to completely retain the dimensional stability of the fabricated article. This is as true of individual particles if they are not homogeneous in the mass, as it is of the total article itself. Although the extruder or calender may cause the individual particle to be flattened or depressed, this change is not a permanent effect.

Plasticizer Absorption

Changes in flow-viscosity are most probably a direct result of preferential plasticization wherein plasticizer absorption is involved. Plasticizer absorption is a variable that depends on production technique and conditions of plasticizer addition. All or nearly all polyvinyl chlorides are produced by either the emulsion or suspension polymerization technique. Each technique has its advantages, and each produces materials of somewhat different characteristics.

In the case of emulsion systems, initiation of polymerization takes place at or in the "soap" micelle, and the polymer chain formed acts as a nucleus for further growth. The polymer can adsorb monomer and, just as

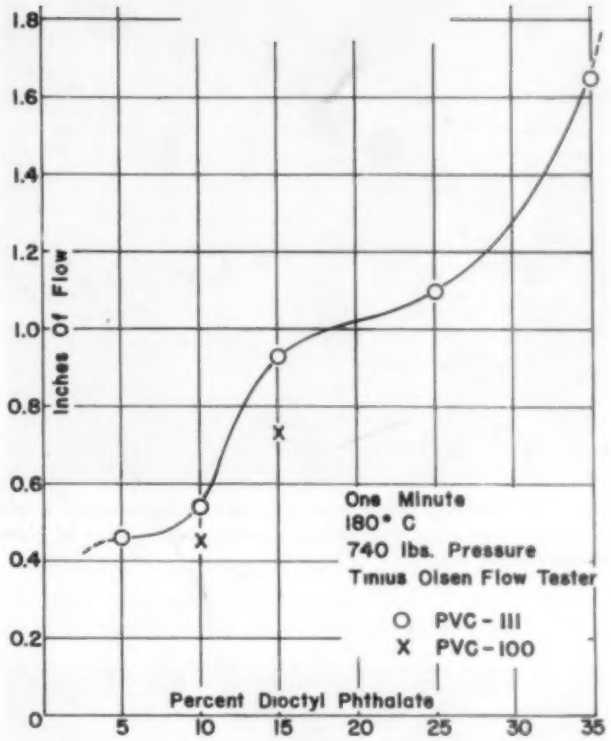


Fig. 1. Effect of dioctyl phthalate plasticizer content on flow of Dow PVC 111 resin.

the micelle provides the locus of initiation, the adsorptive capacity of polymer for the monomer provides an analogous situation Consequently, growth of the emulsion particle results from a continued polymerization at and through the porosity of the initial chains.

Thus, there could be pictured at first a randomly-coiled chain saturated with adsorbed monomer. As sufficient chains form to create a stabilized structure, further polymerization occurs through the initial porosity and into the adjacent monomer area. As pores develop, monomer diffuses to the growing particle to keep it saturated. The net result is a particle which is essentially non-porous and perhaps 1,000-2,000 Angstrons in diameter. When intended for use as a resin, the emulsion particles are coagulated and processed so that, as far as the resin user is concerned, the macroparticles can be thought of as clusters of grapes; i.e., non-porous spheres agglomerated with variable voids between them.

Bonding of the basic particles into handleable agglomerates is difficult to control because of the high tack temperature of PVC itself. Because of the small ultimate particle size (and the resulting high surface area), pre-

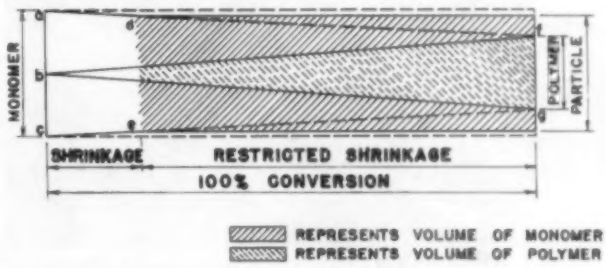


Fig. 2. Diagrammatic representation of controlled particle size granulation.

Fig. 3. Photomicrograph showing plasticizer acceptance of a low plasticizer-absorption vinyl resin. Arrows point to edge of plasticizer-flooded area.

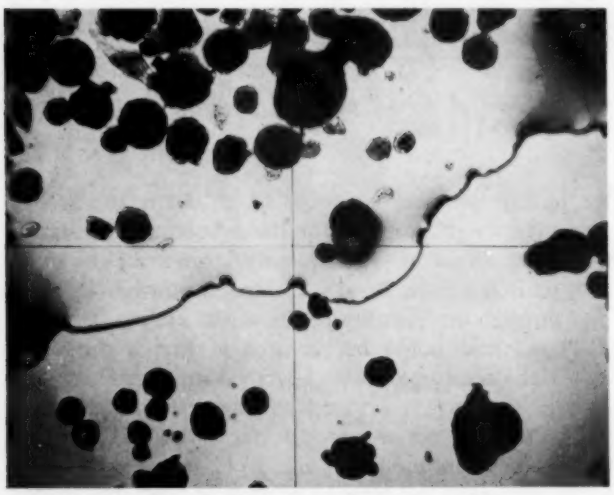


Fig. 4. Photomicrograph showing plasticizer acceptance of a normal plasticizer-absorption vinyl resin.

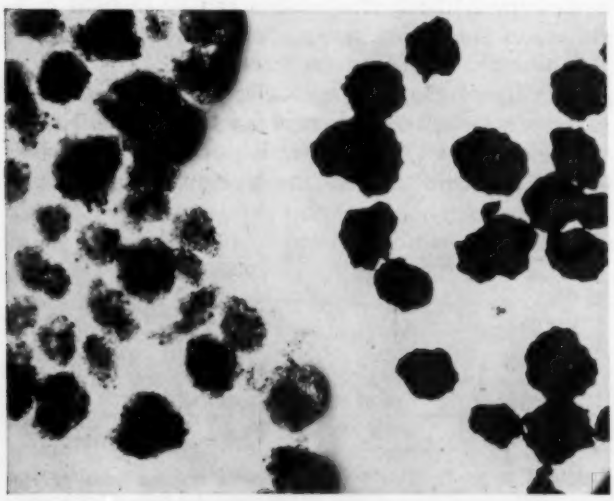


Fig. 5. Photomicrograph showing complete plasticizer acceptance (left hand portion) by a vinyl resin.

fluxing as a result of solvation and diffusion of the plasticizer cause difficulties in some operations. This is especially true of copolymers.

Since oil-soluble catalysts are used in suspension polymerization to cause polymerization in the dispersed monomer droplets, the development of porosity can most easily be described by considering a spherical droplet of monomer. In actual practice, irregular particles result from fragmentation and agglomeration of the polymerizing droplets.

Figure 2 depicts the polymerization of a droplet without diffusion to or from it, and without fragmentation. Here, the line ac represents the volume of the monomer bead. With the onset of polymerization, the bead will start to shrink due to the greater density of the polymer. If shrinkage were to continue to 100% conversion of monomer to polymer, a bead having a volume of fg would result.

This is not the case, however. At some conversion indicated here by the volume in the conversion range of de, the structure of the bead will stabilize; i.e., there is sufficient polymer to form a rigid internal structure and the apparent volume will thenceforth be constant. Some idea of the magnitude of change can be obtained from an example using an estimated polymerization temperature of 50° C., and densities of 0.85 for vinyl chloride and 1.4 for polyvinyl chloride. Thus, one cubic centimeter of vinyl chloride would weigh 0.85 gram, but an equal weight of PVC would have an absolute volume of only 0.6 cc.

This particular mechanism of structural stabilization is possible because polyvinyl chloride is insoluble in its monomer. The conversion at which stabilization occurs is estimated to be less than 30%. The peripheral structure size is established, therefore, and any further conversion of monomer to polymer will result in a shrinkage of the internal volume, thus pulling voids into the polymer. After structural stabilization, the porosity is the actual volume of polymer divided by the apparent volume since the monomer will devolitionize. The tendency for polymer solube-in-monomer systems is for shrinkage to continue almost to if not until completion of polymerization, thereby making non-porous particles.

The ability of these materials to absorb plasticizer can be described by the following two terms:

INTERSTITIAL—This is the porosity resulting from capillarity created by the voids between non-porous spheres produced by the agglomeration of non-porous emulsion particles, or by voids resulting from the agglomeration of suspension fragments.

POROSITY—This is the true porosity derived from fissures created by shrinkage from polymerization after the internal structure stabilizes in suspension (or mass) systems.

To these two terms must be added one further component, which is related to the polymer composition itself and to the nature of the plasticizer. This is:

DIFFUSION—The permeation of the resin by the plasticizer. This permeation depends on time, temperature, solubility, surface area, and the other factors normally associated with diffusion.

Based on these definitions, the controlling factors for plasticizer absorption in emulsion-type polymers are the interstitial and diffusion components. In the case of suspension polymers, the true porosity as well as interstitial and diffusion components are brought into action.

A finished product free from fish-eyes requires understanding and care from monomer to finished product. At Dow, the fish-eye problem is recognized as starting with the polymerization recipe and its ingredients, and extending through to the resin consumer. The recipes are adjusted to give free-flowing powders of uniform porosity. Coarse particles are eliminated because they cannot compete with fine particles for plasticizer and, therefore, are potential fish-eyes. Rigid inspections are maintained to eliminate horny polymer which can result when further polymerization occurs in the interstices of older polymer, thereby decreasing its porosity.

Two different molecular weight resins have been developed which are free-flowing, non-dusty polymers having very high plasticizer adsorptions. These resins are available as experimental PVC's Q-903 and Q-904 from Dow.

Figure 3 is a photomicrograph showing the plasticizer acceptance of a low-plasticizer absorption resin when flooded with plasticizer. Note the edge of the flooded area (arrow), and the fact that little difference is apparent between the resin particles.

Figure 4 shows the plasticizer acceptance of a normal resin. When flooded with plasticizer and examined under a microscope by transmitted light, unplasticized polymer and non-porous portions of the polymer particles appear dark, whereas the particles which saturate with plasticizer appear translucent.

Figure 5 shows the complete acceptance of plasticizer by a resin. The tiny dark spots are believed to be air pockets created by enveloping with plasticizer.

Other Causes of Fish-Eyes

Although the resin manufacturer can do a lot toward alleviating the fish-eye problem, it should be recognized that the problem is not completely in his hands. Some of the possibilities which may produce fish-eyes in essentially fisheye-free resin are as follows:

(1) Dirt, lint, and fibers.
(2) Cross-contamination with a higher molecular weight resin.
(3) Cross-contamination of a fine-particle resin with a coarse-particle resin.
(4) Cross-contamination with a resin of lesser porosity which cannot compete for plasticizer.
(5) Contamination of fused material with unformulated resin.
(6) Techniques of blending are especially important in order to assure that each particle approximates its fair share of plasticizing ingredients.

Surprisingly enough, fish-eyes can be produced in resins of very small ultimate particle size under certain conditions where the plasticizer solvates enough of the resin to seal off a portion as a "dust ball."

We know that composition distribution can and does occur in copolymers, and that all polymers contain some array of molecular weight distribution. As long as this distribution occurs on a molecular basis within a given particle and all other particles are similar, there should be no problem with fish-eyes.

One of the more important concepts to be gained is that in most cases a good resin may be made poor by trace contamination with other good resins. Although blends of appreciable quantities can be made, the critical conditions are where contamination quantities of distinct particles are involved that are of lower porosity or higher average molecular weight.

—The End

Vinyls Give Voice to Talking Toys

Six records pressed from one vinyl disc. Talking assemblies in foreground.

Talking toys get their voices from tiny rigid Geon vinyl records which are placed inside their bodies by Ideal Toy Corp., New York, N. Y. The talking assembly consists of record, plastic case, cardboard diaphragm, and wire crank which sets the mechanism in action.

The miniature records, which are manufactured by Ted Duncan, Inc., North Hollywood, Calif., produce up to 25 seconds of sound. A reset mechanism effects continuous repeating, and the records have been certified by independent testing laboratories as functional after 6,756 plays. The long-wearing record material is specially compounded by Collins, Caldwell, and Dague, Paramount, Calif., using B. F. Goodrich Chemical Co.'s rigid Geon vinyl resin as a base.

Grooves are 40% wider and deeper than conventional records, and the master plates are cut with a special stylus developed by Duncan. Six records are pressed on one standard 10-inch vinyl disc, and die-cut three at a time. The inside groove terminates at a point enabling the automatic spring-loaded reject lever to initiate replay.

Ted Duncan sold 1,226,000 talking units in 1954, and 2,400,000 in 1955. The plant produces a minimum of 10,000 units a day, and has a daily capacity of 50,000 units. Ideal dolls also feature heads of Geon based vinyl resins.

—The End

BENJAMIN SOKOL, *Supervisor of Non-Metallics Section,*
Republic Aviation Corp., Farmingdale, L. I., N. Y.

Recent Developments and Current Problems in Plastic Tooling

A detailed discussion of recent developments, current problems, and the future outlook for plastic tooling.

Tools made of plastics are today no longer considered experimental curiosities. We have arrived at a point where we can say with pride and assurance that plastics have replaced, not substituted for, metals in many tools. The development of tooling plastics and plastic tools has generally followed the development of the aircraft industry. It is only within the past three or four years that other industries have come to realize the tremendous potential inherent in this new field.

Essentially, plastic tooling offers the most to those production industries where many identical units must be made. In large-unit production industries where massive tooling and frequent tooling changes are common, plastic tools have made the greatest progress. Initially, effort was directed toward substituting plastics for metals in order to conserve strategic metals and to save labor. Many of the early plastic stretch forms and form blocks did conserve strategic metals, but failed to save labor; in fact, owing to fabrication difficulties, poor quality, and short life, some cost more than the metal they replaced.

As new materials and techniques were developed, it became possible to effectively substitute plastics for metals in tools such as trim fixtures, drill racks, and checking fixtures. Using glass cloth and glass mat as high-strength reinforcements, laminated structures were made that were capable of serving the same functions as equivalent metal tools. In its early stages, this mode of construction necessitated considerable labor in the painstaking lay-up of the laminate. Slow as this was, it represented a major advancement. Polyester resins were used for this purpose in both heat curing and room temperature curing formulations. Frequently, the laminate would warp in hardening. It became apparent that new materials and techniques would have to be developed in order to effectively compete with metal tooling.

Progress was relatively slow until a new family of resins, the epoxies, became available that appeared to offer considerable improvement in strength, shrinkage control, and general versatility over existing resins. At present, the epoxy resins are effectively replacing both the polyesters and phenolics as tooling resins. Today, it is possible to make out of plastic almost any forming tool conventionally constructed of metal. By the use of various construction methods, reinforcements, resin modifiers, and mold designs, it is possible to economically compete with and generally replace metal tools.

Although early plastic tooling development favored

the laminated type of structure, recent thinking has trended in the direction of cast structures. This is due to the fact that considerably less labor and cheaper materials are involved in casting than in carefully laying-up successive layers of reinforcement. It is possible now to cast filled epoxies to any shape with no measurable shrinkage. With this trend, we are fast approaching our goal of replacing metals in all forming tools.

One of the most grimly-sought tools was the plastic drop hammer die. After many years of trials and disappointments, even this high impact-type of metal forming tool has yielded to plastics. Every modern drop hammer shop today uses plastics in its dies, and this has come to pass in a little over one year.

One of the areas of the tooling industry which has always been taboo for plastics has been that of tools for cutting or blanking metal. Through certain techniques, we are now able to compete successfully even in this phase of tooling.

A similar operation may be done in casting the female die face; in this case, a harder and less flexible resin is used. Capping has the advantage of reclaimability of the kirksite after the tool has outlived its usefulness. Thus, a punch and die having a face area of four square feet might contain eight cubic feet (3,500 pounds) of kirksite costing $630, and 2.3 cubic feet of plastic cap (200 pounds) costing $165. Of this total, the $630 worth of kirksite is reclaimable. At Republic, we have more than 400 plastic-capped kirksite drop hammer dies in operation. These tools have been weathered outdoors with no apparent harm. Figure 1 shows one of the largest plastic-capped drop hammer dies ever made at Republic.

All-plastic drop hammer dies are also being made by casting the die against a plaster face pattern and, recasting the punch against the die (see Figure 2). The resin formulations for the all-plastic tools are essentially the same as for the plastic-capped tools. Steel mounting bolts are cast right into the punch. The prime advantages of this system over the capped system are lighter weight, lower tool cost in labor and materials, lower capital equipment required, and shorter time to produce. The disadvantage is its lack of reclaimability.

The most recent development in plastic drop hammer dies is the single-casting operation of a heavily filled epoxy resin. This material has a low cost per pound, high impact strength, and no measurable shrinkage. It cures hard in four hours, but never exceeds an exothermic temperature peak of 175° F. Starting from a face plaster of the hammer to be made, the completed tool (male and female) of this material can be finished in eight hours. It should be noted that patent application has been made by RAC covering the materials and techniques involved in this process.

Stretch Form

Early plastic stretch forms were made of heavily-filled phenolic casting resins. Their inherent brittleness and high curing exotherm, with its concurrent shrinkage, doomed this type of construction as soon as a slightly

[1] Republic formulates and mixes all of its epoxy tooling resins. Similar formulations and techniques for handling same are available from many resins formulators.

Fig. 1. One of the largest plastic-capped drop hammer punch and die sets made at Republic. Set weighs 39,000 pounds, and has 450-pound plastic cap.

better method appeared. This improvement consisted of a filled phenolic cast as a cap on a plywood egg-crate core. This construction gave way, in turn, to a phenolic cap backed with a foamed phenolic body and mounted on an "I" beam reinforced steel base (see Figure 3). This system is in common use today in many parts of our country. Further development led to a construction consisting of an epoxy-glass cloth laminate shell filled with foamed phenolic mounted on a steel "I" beam reinforced steel base (see Figure 4). Further work has substituted ordinary concrete for the foamed phenolic.

Fig. 2. Examining metal part formed on plastic-capped drop hammer dies. Punch and die have kirksite bases. Punch is capped with flexible epoxy, while die is capped with rigid epoxy.

Fig. 3. Stretch press dies constructed of solid phenolic cap backed by a foamed phenolic core and mounted on an I-beam reinforced steel base. Steel loops at ends of tool base are for handling, while pin-lugs at ends of working surface accommodate a rough-trim fixture used to mark the formed skin before removal from the die.

Some companies have made stretch forms by mixing epoxy resins with sand and gravel in a conventional concrete mixer. It is also possible to make very light stretch forms by utilizing relatively thin-walled, hollow laminated structures with little or no internal reinforcement. Current development at Republic consists of the heavily loaded, low cost, filled epoxy material (mentioned earlier), in both a cored (hollow) structure and a solid casting.

Recent Developments

Plastic Drop Hammer Dies

Drop hammer dies are made conventionally by casting a kirksite (92% zinc) female die to the approximate contour desired, and then handgrinding to the finished contour. After this, a lead male punch is cast against the kirksite. When this set of dies is delivered to the drop hammer and mounted in place, the lead punch has to be beaten and scraped into proper shape.

Earliest plastic drop hammer dies were cast solid of such materials as ethyl cellulose, cellulose acetate, and cellulose acetate butyrate. The difficulties inherent in the manufacture and use of hot-melt thermoplastic dies preclude the general use of such tools. These difficulties include excessive shrinkage upon cooling, costly capital investment, and poor weatherability. Still, the use of these thermoplastic dies persists in some plants even today.

Fig. 4. Stretch press dies constructed of an epoxy-glass cloth laminated shell filled with foamed phenolic and mounted on an I-beam reinforced steel plate. These dies form aluminum fuselage skins for the F84F Thunderstreak.

Other types of construction that enjoyed limited success were the glass roving or cloth-filled polyester dies, and the epoxy-glass laminate dies backed with a filled epoxy body. Both constructions require excessive tooling man-hours, but they result in serviceable tools. In general, current fabrication uses either a flexible epoxy capping on a metal body or a single-pour filled epoxy casting. These two types require the least amount of man-hours.

The capping operation is practical for companies where a great number of kirksite tools are in existence. In this case, when the tool is sent to the foundry to have a new lead punch poured (and this occurs quite frequently), the punch is rough-poured of kirksite against the existing kirksite die. One inch of clay is affixed to the vertical walls of the die to leave a gap in the metal punch which may later be filled with plastic. After cooling, the punch and die are parted, the punch surface cleaned, and the die surface waxed. The two dies are mounted while separated by approximately one inch, the opening and a flexible epoxy resin[1] poured into the face gap and around the sides and top of the punch. The top naturally cures level to the base of the die, so that no further topping is necessary when the die is installed in the hammer.

Embedding of Large Parts

Recently, it has become feasible to bed large, irregularly-shaped parts on a machine table such as a Rockford planer, Onsrud miller, etc., in order to hold them rigid during machining (see Figure 5). To accomplish this, a dam slightly larger than the part to be held is placed on the bed of the machine, catalyzed epoxy resin poured into the dam, and the part is lowered into the liquid resin. The resin is hard within 30 minutes and machining may commence at any time thereafter.

This process is particularly useful for machining large forgings or flat plate, since little or no stress is induced into the metal part when held in this manner. Vacuum chucks for holding specially-shaped parts have also been made in this fashion.

Cutting Tools

The area where least progress has been made in plastic tooling is in the field of cutting tools. This has been due to the fact that no plastic, filled or otherwise, has yet been devised that can maintain a sharp, strong, hard cutting edge. In venturing into this field, we were able to achieve limited success by employing a metal cutting edge at the point where it was required. Since any cutting tool cuts only along a given line or series of lines, it was reasoned that if these edges could be made of metal and the balance of the tool made of plastic, an effective cutting tool should result. The reasoning proved sound.

Steel rule dies utilizing plastic to hold the steel rule in place (see Figure 6) were made, and success in constructing several of these tools encouraged us to go further. We combined a steel rule die with a plastic

forming die and, thus, manufactured a form and blank die. We have found it possible to form a part in the first phase of the die-closing operation, and to blank it out of the sheet stock in the last phase of the closing operation. This is done in one motion, and does not require a double-acting press nor a second-action in the die. Republic has made patent application on this device.

Master Forms

Master forms have been made conventionally in the aircraft industry by wiping-in various plasters between fixed metal or wood templates. Since plaster weathers very poorly, storage of these masters has always presented a costly space problem. Movement of these masters represents a handling hazard because of the fragility of the plaster construction.

Recently, several resin formulating companies have offered splining compounds for use in making master forms. The template body of the master is made up in the conventional manner, then wire mesh is affixed within ⅜ inch of the final surface. A heavy, putty-like filled epoxy is spread on the screening and up to within 1/32 inch of the desired outer surface. A final layer of smooth filled-epoxy material is splined onto the outer surface.

This construction results in a very strong, accurate, durable, weather-resistant master form which can be given outdoor storage. It further allows many duplicates to be made from the same surface without injury to that surface. Normally, plaster masters would present a parting problem, when plastic tools are repetitively made from the same surface. This problem is essentially eliminated by the use of a smooth plastic surface on the finished form.

Parting Agents

When using plastics for tooling, it is invariably necessary to mold the tool against some surface. If this surface is a hard, smooth, and non-porous, little difficulty will result. The problem of developing suitable parting agents is one that has plagued the plastic tooling field since the introduction of epoxy resins. After considerable evaluation, we have determined that the only sure parting agent is a smooth, continuous, physical barrier coating. The actual material of this coating is not so important as the technique of its application.

After evaluating almost all the available parting agents and combinations thereof, we have found the following system to be most successful: One coat of Simoniz (or equivalent) wax, followed by a brush or spray coat of Coverlac 242C,[2] and followed by a final coat of Simoniz (or equivalent) wax. This system will work on any surface, regardless of porosity or moisture content.

Parting from a uniformly porous medium such as Hydrocal B-11 can often be accomplished by covering the surface with two or three coats of Simoniz wax. This may not be too satisfactory if the plaster is damp, since the moisture will inhibit the cure of the epoxy surface resin.

The quickest, simplest and most inexpensive parting agent we have found to date is an unsupported vinyl or polyethylene film of up to 0.005-inch thickness. This film can be stretched over the contour to be molded, and the plastic tool made directly on this film. When the tool is completed, the film parts easily from both the mold and the tool. Concave surfaces are handled by holding the film in place either by vacuum or by lightly greasing the surface upon which the film is placed. This positive type of film barrier may be reused many times.

[2] Made by Spraylat Corp., New York, N. Y.

Fig. 5. Machining a large titanium skin bedded in a formulated epoxy resin.

Checking Tools

A new technique has been perfected for rapidly making durable, lightweight contours and trim checking fixtures. This method consists of brush-applying a coat of surface resin containing a fine abrasive filler and backing this surface, before it cures, with a putty-like resin. Before the mass cures, paper-base phenolic tubing is mushed into the putty, and two or more phenolic tubing legs are attached. The entire mass cures in about an hour and is then ready for use. The process is generally limited to tools up to three feet in length. Figure 7 shows such a tool used for contour checking of a drop hammered part.

Current Problems

In a paper presented last year before the Society of Plastics Engineers, we made mention of Republium, an ideal but non-existent plastic. We can itemize once again the wondrous properties of this ideal plastic, for therein lies our current problems and our future work. These

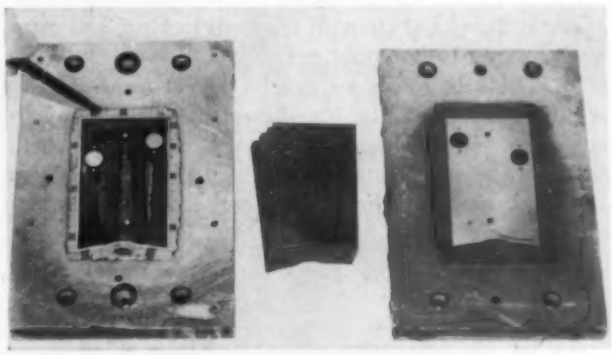


Fig. 6. Steel rule blanking die set utilizes epoxy resin to locate and fix the cutting rule. This tool can cut aluminum and steel up to 1/8-inch thick. Blanks shown (center) are 0.064-inch thick steel.

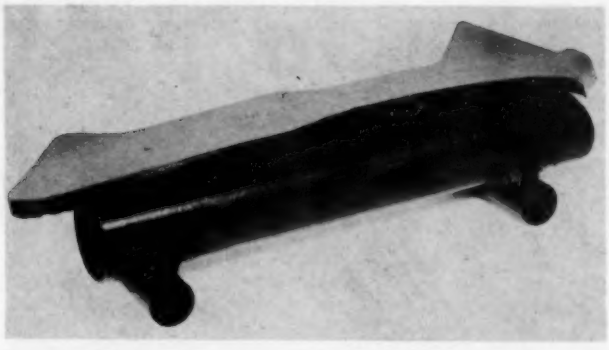


Fig. 7. Checking fixture used to inspect the contour of a drop-hammered part. Tool weighs 10½ pounds and is constructed of a plastic putty and a paper-based phenolic tubing.

properties are as follows:

(1) Stable; non-shrinking during cure; weather resistant; inert to all common solvents and oils; and no dimensional change with time (low creep).

(2) Tough and hard (Barcol 95), but modifiable to the resilience of 40 durometer rubber; and high impact strength.

(3) Physical properties:

	Unreinforced	Reinforced
Compressive strength, psi.	60,000	100,000
Tensile strength, psi.	60,000	100,000
Tensile modulus of elasticity, x 10^6 psi.	6	10

(4) Heat resistant—high heat distortion temperature (350° F.); non-flammable; and low thermal coefficient of expansion.

(5) Cured controllably at room temperature, with a low exotherm.

(6) Capable of casting and laminating; and can be mixed with other resins and fillers to obtain different properties.

(7) A good adhesive.

(8) Low specific gravity, and low in cost per pound.

Unfortunately, this wondrous material is still non-existent, but some of its close cousins are available. The epoxies and their copolymers, using various fillers, come close to satisfying the requirements. Today, we have plastics that compare with Republium's properties as follows:

(1) Essentially met, except for the need for lower creep.

(2) Definitely met.

(3) Stiffness and strength are both lacking, and much work has yet to be done here.

(4) The heat resistance can be met at some sacrifice of dimensional stability. Non-flammability can be met at sacrifice of strength and resilience. Low thermal coefficient can be met by the use of high filler loading, but at the sacrifices of other properties. Much work has yet to be done on these items.

(5) Definitely met.

(6) Definitely met.

(7) Definitely met.

(8) Specific gravity may be varied from 0.1-6 (foam to heavy fillers), but the cost per pound is still high. The epoxies may never go below $0.50 per pound, due to the high cost of the raw materials. The use of fillers and copolymers helps reduce the apparent cost per pound of material. Much work has yet to be done on this.

From this, it can be seen that current problems and future development point to the areas of creep, stiffness and strength, heat resistance, non-flammability, thermal expansion, and cost of materials. To this can be added the removal of cured epoxy resins.

Creep

Most of the problems involved in plastic tooling are transient; i.e., they confront us at the moment, but are quickly solved. Some of these problems, however, are inherent in the material that we use, and the most important of these is creep.

It has been our sad experience that apparently well-made tools showed an alarming warpage after brief use. Until a thorough investigation of the problem was made, this warpage was assumed to be due to incomplete cure of the resins used. It became apparent, however, that this warpage was much more a function of creep of the plastic material than one of insufficient cure. All materials creep to a certain extent under load, but plastic materials by their very nature are particular offenders. After more than a year of work on the problem, we have come to the conclusion that the creep problem can more easily be handled mechanically than chemically.

We have found that different families of resins exhibit different rates of creep. For instance, the polyesters creep more than the phenolics, and phenolics creep more than the epoxies. We also have found that the greater the degree of oven-curing given the resin, the less its tendency towards creep. Since oven-curing of plastic tools encourages distortion, this solution to the problem is not satisfactory. Although an oven-cure of over 150° F. may improve the creep properties of the tool, it will generally decrease its dimensional accuracy.

We have evolved a rule-of-thumb method of designing plastic tools wherein we maintain a span-depth ratio of 8:1 or less. In this way, by improving the rigidity of the tool as a whole, we reduce the unit stress (and, hence, the creep) in any part of the tool.

A great deal of work remains to be done on this problem. It may be that the apparent effect of this phenomena can be reduced by incorporating reinforcements in the tool. We know, for instance, that the use of most fillers will reduce creep up to a point. If this problem can be solved, we can safely say that there will be virtually no limit to the size of plastic tools.

Stiffness and Strength

As pure resins go, the epoxies bow to none. Their stiffness and strength are superior to all other resins; however, they are poor when compared with tooling metals. Unfilled epoxy castings exhibit a flexural strength of 18,000 psi. and a modulus of elasticity of 0.5 x 10^6 psi. When made with the strongest reinforcement feasible (glass rovings), a flexural strength of 100,000 psi. and a modulus of 4.5 x 10^6 psi. are possible.

Neither of these extremes can be used in tooling, however, due to inherent fabrication difficulties, so that tooling epoxy formulations fall within and generally toward the low end of this range. A great deal of work

must be done to develop stronger resins and resin-filler systems.

Heat Resistance

High strength heat-resistant resins could enjoy a considerable tooling market if they were available today. The metaphenylene diamine- and pyromellitic dianhydride-cured epoxy resins, when properly filled, approach what we would consider an acceptable high-temperature tooling material. These materials can be cast to make tools to operate in the 250-350° F. range.

Unfortunately, the strengths of these materials decrease with an increase in temperature, and with time at temperature. Their low strengths necessitate the use of metallic restriction boxes and similar reinforcements. In addition, repetitive heating and cooling cycles apparently induce embrittlement. When using the material in a set of heated, mated laminating dies under pressure, the laminate reinforcement tends to impress itself in the mold surface. After several mold cycles, this effect becomes pronounced and begins to aggravate part extraction problems. The use of an extremely hard mold-surfacing filler, such as finely-divided silicon carbide, will reduce this effect.

Hot dies are used in the hot forming of magnesium parts. These tools must be painstakingly hand-ground to such shape that when the formed part cools to room temperature it will be of the desired configuration. It would be wonderful if a plastic tool could be made having the same thermal coefficient of expansion as magnesium, so that it could be cast directly to the desired shape. Needless to say, the tool would have to retain its strength while withstanding a continuous operating temperature of 650° F.

Non-Flammabilty

Flame resistance in a tooling plastic permits it to be used for such tools as welding fixtures. Imparting flame resistance to epoxies necessitates the inclusion of halogenated compounds such as Chlorowax, along with fillers such as antimony oxide. In general, the amount of inclusion must be so heavy as to seriously impair the properties of the material. Resin formulators might well devote development time to this problem.

Thermal Expansion

Virtually all materials expand when subjected to an increase in temperature, and plastics as a group expand more than metals. In tooling, this causes grave problems because a plastic tool made against a metal master during the winter may not match that master in the summer. Formulated epoxies can heat-expand from 1-6 times as much as kirksite.

By judicious use of fillers, the expansion of the tooling plastic can be controlled. It has been found that the coefficient of thermal expansion of the resin varies with the amount and type of filler used. With an increase in filler, the cured plastic approaches the coefficient of the filler material. If a large filler particle size and a minimum amount of resin are employed, the thermal expansion will tend to follow that of the filler.

Companies in the tooling resin formulating field should give attention to development of formulas that will maintain good strength characteristics while exhibiting the same coefficients of expansion as either steel or aluminum.

Coat and Reclaimability

Two of the factors that tend to retard the use of plastics for tooling are the high cost of the raw material and its lack of reclaimability. Formulated epoxy tooling resins vary from $0.60-2.00 per pound, while tooling metals vary from $0.05-0.75 per pound. It can be argued that this is an unfair comparison because of the great difference in densities between the plastic and metal; therefore, the plastic could cost less for a given volume of tool. Taking this into consideration, a more equitable comparison might be on a volumetric basis in terms of cost per cubic foot of tool. When this materials factor is multiplied by a factor indicative of the relative tooling labor required, the resultant figure is an effective measure of the value of the material as a tooling medium. Table 1 lists such comparative figures for some common

Table I. General Cost Comparison of Common Tooling Materials*

Tooling Material	Material Comparison Factor $/cu.ft.	Labor Comparison Factor**	Resultant Comparison Factor $/cu.ft.
Aluminum	85	8	680
Kirksite	80	8	640
Steel (boiler plate)	35	12	420
Laminated glass cloth-epoxy	75	6	450
Unfilled epoxy (cast)	90	2	180
Phenolic (cast)	45	2	90
Heavily-filled epoxy (cast)	20	2	40

* Basis: One cubic foot at tool, typified by a press block.
** This figure is dimensionless, based only on the relative amount of labor required for grinding, machining, or casting the tool.

From Table 1, it is obvious that although glass cloth-epoxy laminates are known to have a high strength-to-weight ratio, their material cost is high. It is also apparent that the casting plastics cost less to work with because of the small amount of labor required in their use. In actual practice, combinations of metals and plastics are used in most plastic tools.

A further consideration is the reclaimability of the tooling material. In the case of the metals, from partial to full value in reclaimability is possible. In the case of the thermosetting plastics, no reclaimability is economical. Thus, a typical press block of four-cubic foot volume in kirksite would cost $880 and have a $300 reclamation value, while the same tool in a cast epoxy would cost $400 but have no reclamation value[3]. From a pure cost-of-tooling viewpoint, therefore, there is little to chose between the two.

However, as the volume of the tool increases, the kirk-

(*Continued on page 401*)

[3] Both the kirksite and plastic require a plaster face pattern of the tool. The kirksite requires this for blue-blocking, while the plastic is cast against it. A sum of $120 was allowed for this pattern in each tool.

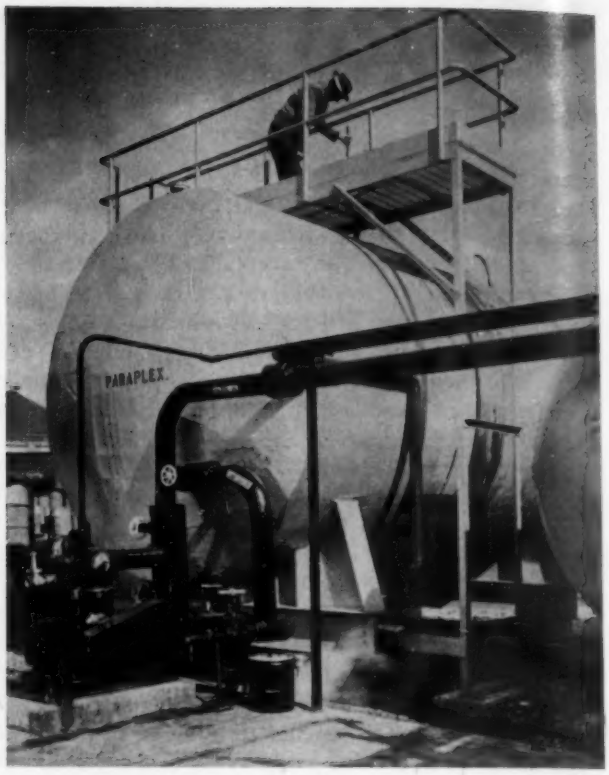


Fig. 1. Access manhole at top of storage tank permits cleaning and inspection of tank and checking of resin level.

Storing and Handling Polyester Resins in Bulk

Owing to the increasing trend towards purchasing polyester resins in tank-truck quantities, Rohm & Haas Co., Philadelphia, Pa., has compiled a set of recommendations for storing and handling these materials in bulk. These recommendations apply only to polyester resins of moderate viscosity and are based on the company's own experience. They are offered primarily as a guide for adaptation to specific plant operation conditions.

Storage tanks should be of stainless steel; the higher initial cost is usually justified by the material's superior resistance and longer service life. Some economy can be realized by using stainless steel-clad tanks, but all connections should be of solid stainless steel. Mild steel should be avoided because iron oxides are a weak accelerator for most polyester resins.

The storage tanks should have a capacity of about 4,000 gallons to handle one tank-truck load. Larger volume consumers who use a tank-truck load in less than two weeks will usually find 8,000-gallon storage tanks to be more economical. When long periods elapse between refillings, the tank should be completely emptied and inspected before each filling. This prevents leaving a "heel" of resin that might gel in the tank if left undisturbed for an appreciable period of time.

The tanks should have a manhole to permit access for cleaning and inspection, and a three-inch IPS bottom outlet for complete draining. When cleaning the tank, the usual safety precautions should be followed for volatile, inflammable materials. Resin level can be checked most conveniently through the top of the tank (see Figure 1).

Polyester resins should be maintained at a temperature of 60-90° F. during storage, and the tank should be equipped with a temperature indicator having a stainless steel bulb or thermowell. Because the reduced viscosity of the resin below 60° F. creates difficulties during pumping, and because the resin should not be heated, outdoor storage is ruled out in most localities. If the storage temperature is likely to exceed 90-100° F. for extended periods of time, the tank should be

insulated with about two inches of mineral wool or glass wool. A non-insulated tank can be kept cool with a trickle of water flowing over the shell.

In humid locations, substantial quantities of moisture can be drawn into the tank as the resin level drops, and will condense as the atmosphere cools. A drying unit containing activated alumina or similar desiccant installed on the tank vent will prevent moisture intake. Alumina which contains a color indicator gives a convenient guide to the remaining drying capacity. Exhausted alumina can be reactivated in a drying oven; or the desiccator units can be purchased with a built-in heating element so that the alumina can be reactivated without removing it from the unit.

Because of the viscosity characteristics of polyester resins, pumping equipment and piping lay-out should be planned by an engineer familiar with viscous fluid applications. A positive-displacement type of pump having flooded suction is essential. For this service, Rohm & Haas uses a heavy-duty, all-bronze pump with V-belt drive, and equipped with a head-mounted relief valve and an extra outboard bearing between the pump and the drive-belt sheave.

The feed line to the pump should be as short as possible, and large enough to avoid starving the pump (see Figure 2). A straight run is recommended; if elbows are required, they should be 45° bends rather than 90°. A basket-type strainer constructed of 16-mesh stainless steel wire should be installed on the suction side of the pump.

Distribution lines should be of thin wall stainless steel pipe or tubing, and steel or brass lines and fittings should not be used. A minimum line diameter of two inches is advisable, and a three-inch line will be necessary in some cases. The pressure drop in the system should be calculated carefully before specifying distribution and pumping equipment.

Facilities should be provided for draining the lines (see Figure 3). Distribution lines may remain filled during normal production periods, but should be drained for shut-downs longer than 24 hours. Like the tanks, distribution lines should be protected to keep resin temperature between 60-90° F. Flanged connections should be installed at regular intervals to permit cleaning the lines whenever necessary.

Fig. 3. Draining distribution lines for polyester resin if the process shuts down for 24 hours or longer.

Valves should be of the full-flow type, such as gate valves and plug cocks. Stainless steel valves are preferred; bronze valves can be used if the resin is not permitted to remain in contact with the valves long enough to pick up an appreciable concentration of copper (a mild inhibitor of polyester polymerization).

—The End

Fig. 2. Transferring resin from storage tank to tank-truck by means of a positive-displacement pump having a short feed line equipped with a mesh strainer.

Recent Developments and Current Problems in Plastic Tooling

(*Continued from page 399*)

site tool will cost more due to the labor of grinding more tool surface, while the cast plastic tool will increase only by material cost. This explains why massive tools such as stretch forms are made exclusively of plastic. If the cost of the plastic could be reduced and the material made reclaimable, tooling plastics could look to an even rosier future than is now in view.

At Republic, we have been formulating and mixing our own resins for several years. This has saved us over $40,000 during 1955 alone on a tooling resin consumption of 100,000 pounds.

Removal of Cured Epoxies

The very strength and chemical inertness properties of cured epoxy resins that make them so desirable for many applications present a nuisance when it is necessary to remove the resin. For example, the necessity for removing an epoxy cap from a metal tool, would present an unpleasant choice. The cap could be removed mechanically, thermally, or chemically. Mechanical removal would necessitate a great deal of dangerous and time-consuming chipping, grinding, and filing, with the possibility that the tool might be damaged by these labors.

Thermal removal of the cap would necessitate heating the tool in an oven for several hours at 250-300° F., after which the cap would strip off with relative ease, but the heat might permanently distort the tool. To remove the cap by chemical means would necessitate submerging the cap in either chloroform or methylene dichloride for a considerable length of time (a seven-day soak is necessary to remove a two-inch epoxy cap). None of these alternatives are particularly palatable, and better methods of resin removal are necessary.

The Future Outlook

We have attempted to describe in this paper some recent plastic tooling developments, as well as some basic shortcomings of plastic tools. Plastic tooling grew to satisfy a temporary need for cheap, quickly-made substitute tools. It has outgrown that original purpose and, today, has replaced metals in tooling applications too numerous to mention, and has ventured into new fields untouched by the metals.

This has not come about by chance, but by thought, work, and the expenditure of a great deal of effort. During this growth, there have been many successful developments and several glaring failures of plastic tooling. The failures were caused by overconfidence, haste, misapplication, and general lack of thought. We can offer the following challenges to those who would see plastic tooling take a more prominent place in industry:

To the Resin Supplier: Provide a consistently uniform, high-quality product. Improve your product by way of polymer research. Increase the versatility of your product. Reduce your production costs, and pass the reduction on to your consumer.

To the Resin Compounder: Provide your customer with the optimum formulas for a given type of tool. Assist him with technical know-how and information on how to best fabricate the tools he needs. Caution him against using plastics where chances of success are small. One failure can cost you a customer and gain an enemy for plastic tooling. Research in the direction of improved creep properties, higher strength properties, and new tooling techniques.

To the Tool Designer and Toolmaker: Design and build tools to accomplish the job at hand. Use plastics only if by so doing you can gain significantly over conventional metal tooling. Plastics offer wonderful versatility, but they are not a panacea to end all tooling ills. Choose your structures carefully, reinforce them properly, and make them in a manner as to show good workmanship. If you run into trouble, call your formulator for help.

Standardize on tool designs and do not make each tool different. Learn the best structure for a given tool, and maintain that as a standard until a better one offers itself. Experiment with new materials and structures, if you have the facilities, but in so doing always bear in mind the limitations of your medium. Attempt that which looks feasible, but shun the harebrained ideas which have small chance of success.

To the Tool User: Upon the drill jockey, the drop hammer operator, the assembler, the stretch press operator, and other users of tools, the future of plastic tooling depends. In short, do not abuse the plastic tool any more than you would a metal one, but give it the care a tool deserves. If you see some application for the new materials that has not been exploited, tell your tool designer or tool maker.

In conclusion, plastic tooling is no longer in its infancy. Instead, it is a fast-growing youngster who is well established in the industrial household. Some of the noisy metal-banging neighbors consider him to be a juvenile delinquent because he often trespasses into fields they consider to be their own. In addition, he occasionally sports a black eye due to misapplication. However, plastic tooling is a rapidly growing youngster who, by all appearances, will double his size in the next year or so.

—The End

Properties and Applications of Butyrate Pipe

(*Continued from page 387*)

plastic-metal adapters, and Van Stone flanges. Butyrate pipe bends up to 90° can be heat-formed.

Butyrate pipe has been used successfully in the oil fields and natural gas lines; for field sprinkler systems and electrical conduit; and as transfer lines for dilute acid and water slurries, and waste chemicals. Much field experience has been gained with butyrate pipe during the past 11 years, and markets for the use of this material should expand.

Bibliography

(1) L. W. A. Meyer and R. J. Scogin, **Gas**, 31, 3, 62 (1955).
(2) L. W. A. Meyer and R. J. Scogin, **Corrosion**, 11, 6, 277, (1955).

—The End

PLASTIC RAINWEAR is a good example of the way vinyl products can be improved by the right Hercoflex plasticizer specifically chosen to provide the wide range of basic properties needed.

PLASTIC TOYS are another of the end products that give longer service when a Hercoflex plasticizer is used. No matter what the service requirements, there is a member of the Hercoflex family to supply them.

Rain or Shine

HERCOFLEX PLASTICIZERS IMPROVE VINYL PERFORMANCE

No matter what property—or combination of properties—you seek in a plasticizer, there is a Hercoflex that will meet your requirements with "tailor-made" precision.

The Hercoflex family has been developed specifically for those vinyl processors who realize that no single plasticizer can be versatile enough to meet all requirements. That's why so many processors are becoming better acquainted with the Hercoflex family, so that they can select the *one* plasticizer that will do their specific job best.

Whether you want the top performance of Hercoflex 600, the low-temperature flexibility and low volatility of Hercoflex 150, or plasticizers where the major emphasis is on economy, you'll find the answer here.

Would you like to know more? Write to Hercules, outlining your specific requirements, and we'll be glad to send you technical data on the Hercoflex plasticizer that best fits your specifications.

HERCOFLEX®
VINYL PLASTICIZERS

Synthetics Department
HERCULES POWDER COMPANY
INCORPORATED
958 Market St., Wilmington 99, Del.

SH56-1

News of the Societies

NY Reinforced Group Meets

A two-part program was presented by the Reinforced Plastics Group of SPE's New York Section, March 28, at Tufaro's Restaurant in Corona, L. I., N. Y. Over 65 members and guests attended the meeting.

I. N. Einhorn, Budd Co., presented "An Evaluation Report on Expanded Plastic Foams," covering rigid, semi-rigid, and flexible materials. Isocyanates (urethanes), vinyls, styrene, phenolic, cellular cellulose acetate, cellular polyethylene, silicone, and rubber foams were discussed. A summary of the physical and mechanical properties of foams was presented, including density range, cell structure, service temperature, thermal conductivity, moisture resistance, compressive yield strength, tensile strength, shear strength, flexural strength, and flame resistance.

"Epoxy Resins in Reinforced Plastics" were discussed by Bruce E. Godard, Bakelite Co., particularly with respect to the properties of epoxy-glass cloth laminates prepared by wet and dry laminating techniques. The importance of post-cure for optimum properties was stressed. Other features of Mr. Godard's talk included engineering design considerations, paper base laminates, syntactic foam sandwich core structures, and pre-mix molding compounds. Advantages of epoxies were quoted as follows: excellent wetting characteristics, low volume shrinkage, resistance to weathering, and heat resistance.

Two-Part Program in New York

Two topics, diverse in nature, but of pertinent interest to the plastics industry highlighted the April 18 meeting of SPE's New York Section at the Gotham Hotel in New York City. The first half of the program was devoted to the extruded vinyl picture, and featured two speakers: Edward Leimseider of World Plastex, and Peter Groop, Bakelite Co.

"Flexible Vinyl in Consumer Applications" was the subject of Mr. Leimseider's talk, wherein he described the various types of vinyl resins, plasticizers, lubricants, and stabilizers which are available for compounding. Assuming that extruded vinyls find their greatest applications when specifically tailored to the job, he advised which material types and percentages should be used to arrive at the best formulation.

Mr. Groop spoke on "Applications of Extruded Vinyls in the Plastics Industry," covering their market areas in automotive cable wires, extruded vinyl jackets, vacuum cleaner cords, vinyl garden hose, and extruded welting and gasketing. In each case, Mr. Groop spoke of the special requirements for the particular job, and the particular formulation best suited to meet these requirements.

The second half, "Accident & Fire Prevention in the Plastics Industry," consisted of a three-man panel: Louis Buhler, Willard C. Johnson, and Walter R. Kaluta; all of the New York Plastics Industry Safety Group. The panel covered the proper procedure for setting up a safety program designed to cut down the number of accidents to workmen. Such a program could be initiated by organizing foremen and supervisors into a safety committee. This committee could meet at regular intervals, and carry the results back to their respective groups. The basic rules of fire prevention were presented, including proper storage and housekeeping and the installation of a sprinkler system.

Plastic Tooling Advantages

A discussion of "Advantages of Plastic Tooling" was given by Fred Lyijynen, supervisor of plastics development for the Automotive Body Division, Chrysler Corp., in a paper presented at the annual meeting of the American Society of Tool Engineers in Chicago, Ill., on March 19-23.

Mr. Lyijynen stated that plastics are out-performing metals in many cases in the tooling field. Basic tooling of reinforced plastic is now preferred by the large automotive companies because of time and labor savings. Secondary tooling can be made more economically of reinforced plastic, without the need for expensive lay-out work. Some of the plastic tooling which has been used successfully in the automotive, aircraft, and allied industries includes draw dies, form and flange dies, drop hammer dies, hydroform blocks, assembly fixtures, drill fixtures, checking fixtures, contour template panels, die models, prototype models, mock-ups, and assembly models.

An outstanding use for plastic dies has been the production of panels for pilot model runs, where permanent tooling has not yet been completed. Plastic dies are being used to save time and money while ascertaining draw die conditions or the feasibility of making a part in various operations before actual steel die construction is undertaken.

In the discussion period which followed the talk, the speaker noted that 25% of Chrysler's total tooling program is now of plastic, and that this figure should be more than 30% in the near future. In discussing reinforcement of plastic tooling, the use of metal wear inserts was recommended, since metal plating of wear spots does not provide satisfactory adhesion to the base plastic.

Hears Talk on Mylar Film

A talk on Mylar polyester film was given by C. R. McKay, Film Department, E. I. du Pont de Nemours & Co., before the regular dinner meeting on April 16 of SPE's Southern Section, held at Mammy's Shanty, Atlanta, Ga. Using a film to illustrate his talk, Mr. McKay described the properties of Mylar, which include excellent electrical insulating characteristics, immunity to attack by most chemicals, and retention of operating qualities under extremes of heat and cold. These properties have led to the increasingly wide acceptance of Mylar for such uses of magnetic recording tapes; metallized yarns used in fabrics, rugs, and upholstery; electrical insulations; and laminations with other materials where a tough, durable, decorative surface is desired.

In the automotive field, Mylar is being used in metallized yarn for upholstery; in ignition system wiring; and as door panel surfaces. Mylar recording tape resists tearing, does not dry out or become embrittled with age, and can be used in thinner gages to give as much as 50% more playing time per reel.

Plastisol Coating Discussed

J. King Ruhly, Michigan Chrome & Chemical Co., was the speaker of the evening at the regular dinner meeting on April 18 of the SPE Kentuckiana Section, held at the Kennel Club, Evansville, Ind. Mr. Ruhly spoke on "The Applications for Plastisol Coatings."

After a review of the plastisol coating industry and its growth, the speaker stated that the coatings are applied by four methods: (1) hot dipping, in which the part to be coated is heated prior to dipping; (2) cold dipped; (3) slush molding; and (4) spraying. Metal parts to be coated are usually given a phosphate treatment and primer coating before application of the plastisol. The plastic coating generally requires a cure of 6-15 minutes, depending on the size of the coated part. Curing takes place at about 350° F. in an oven having good ventilation and air circulation (good air movement is needed because of the dense smoke given off during cure which may detract from heating efficiency). In the dip process, the material in the tanks should be agitated to keep it at optimum working consistency and to allow the escape of entrapped air. Mr. Ruhly illustrated his talk with many displays of coating applications.

SPE Newark, N. J.

A panel discussion on "Molder-Moldmaker Relationships and Responsibilities" featured the May 9 dinner meeting of the SPE Newark Section. The meeting, the last before the summer recess, was held at the Military Park Hotel and attended by 125 members and guests. E. Keusch, Fiberite Corp., acted as moderator of the discussion led by the four panel members. J. O'Brien, Shaw Insulator Co., and H. E. Hasenzahl, Pro-Phy-Lac-Tic Brush Co., were the molder members of the panel, while E. J. Csaszar, Eagle Tool & Machine Co. and member of PLASTIC TECHNOLOGY's Editorial Advisory Board, and J. A. Kavanaugh, Standard Tool Co., represented the moldmakers.

The discussion began with a short talk by the panel members, followed by a lively question-and-answer period. Mr. O'Brien expressed the belief that the moldmaker's responsibility lay chiefly in accuracy of dimensions and adherence to delivery schedules, and raised such provocative questions as who owns the hob and who dictates the choice of steel used. Mr. Csaszar emphasized the "joint venture" nature of a mold; such items as part design, designation of molding material and shrinkage correction, fitting to the machine, and placing of knock-out pins and cooling channels are primarily the molder's responsibility; while such items as feasibility, mechanical functioning, conformance to design, good workmanship, finish, and fit at parting lines are primarily the moldmaker's responsibility.

Mr. Hasenzahl discussed the problems of mold polishing and delivery schedules, and stated his belief that testing should not be done by the moldmaker. Mr. Kavanaugh deplored the general policy of not paying the moldmaker until after the mold was completed and in operation, and blamed both molder and moldmaker in situations where a moldmaker quotes an unrealistic delivery date in order to get the job and this date is accepted by the molder who should know better.

Vic Blatta, Frank W. Egan Co., has been named membership chairman for the Newark Section, replacing Bob Louis who has been transferred to Chicago.

SPE Cleveland-Akron Section

"Elastomeric Vinyls" was the theme of SPE's Cleveland-Akron Section dinner-panel meeting on April 9. A record attendance of 120 members and guests was recorded for this meeting, which was held at the Spanish Tavern, Brecksville, O.

"Extrusion of Vinyls" was covered by L. A. Mansfield, B. F. Goodrich Co.'s Marietta division, with special emphasis on the properties of vinyl elastomers. Among those considered were color brilliancy, ease of maintenance, long wear, abrasion resistance, and flexibility. Extruded parts show good weather resistance, and do not craze excessively. They have largely replaced rubber in refrigerator gasketing, though care must be exercised in plasticizer choice to avoid migration to styrene parts. Other types of gasketing and seals account for a large portion of extruded PVC's volume.

R. M. Hershey, Hoover Co., spoke on "Injection Molding of Vinyls," stressing both problems and techniques. Most of the problems encountered in molding vinyls stem from poor thermal stability and low heat conductivity which make uniform plasticization difficult to obtain. Molders generally restrict material flow in the nozzle or gates, and use frictional heat to complete plasticization. Mr. Hershey pointed out that best results were obtained with a gate 31 mils in diameter and 62 mils in land length. Cylinder derating was found essential for obtaining a good surface finish, and cylinder temperatures of 350-400° F., were recommended. In spite of higher material costs, vinyl moldings are cheaper than rubber due to the shorter molding cycles required.

"The Vinyls—Variety, Virtues, and Vices" was the subject of a talk by D. F. Siddall, U.S. Stoneware, who discussed the problems encountered in preparing non-toxic vinyl extrusions for food and medical packings. Careful ingredient selection should be combined with constant checks for the presence of lead and other contaminants. Federal laws on toxicity were reviewed.

SPE New York Section

A two-part program was featured at the May 16 meeting of SPE's New York Section, held at the Gotham Hotel in New York City. Approximately 80 members and guests were in attendance.

"Basic Packaging, Handling, and Loading Considerations" were covered by C. M. Bonnell, publisher of "Packaging and Shipping." The primary purpose of any package should be its ability to deliver a product to the ultimate consumer in a useable condition. Concerning terminology, some firms and the government refer to interior containers and wrappers as packaging, and designate the exterior or shipping container as packing. Interior packing has advanced from the three old stand-bys of hay, straw, and excelsior to imbedment in plastic foams. Mr. Bonnell also described the following types of shipping containers in some detail: nailed wooden boxes, fibre containers, solid fibre board, corrugated fibre board, plywood boxes, crates, wire-bound crates, wooden barrels, metal drums and pails, bags, and pallets or skids.

"Auxiliary Mechanisms in Automatic Molds" were the subjects under discussion by Milton A. Sander, Consultant. Considerable attention was devoted to automatic cams and to the various unscrewing mechanisms which have been employed. It was brought out that in many instances the moldmaker does not understand the problems involved in molding, and vice versa. Mr. Sanders also answered a number of questions directed from the floor, largely concerned with mold temperatures and mold closures.

SPE Eastern New England and SPI Boston-Providence

SPE's Eastern New England Section and the Boston-Providence Chapter of SPI held a joint dinner meeting at the Hotel Beacon-sfield, Brookline, Mass., on April 19. Over 125 members and guests attended the meeting, which was based on the theme of "The Exciting Progress of Plastics in the Shoe Industry."

Arthur Staff, Koppers Co., Inc., spoke on "The Past Development of Plastics in Shoes," outlining the problems and the methods by which they have been solved. He described celluloid shoe counters, plastic shoe forms, shower clogs, and bad-weather footwear, displaying samples from both the past and present.

"Design and Development of Plastic Shoe Parts" were discussed by Leo Pranitis, Endicott-Johnson Co., with particular stress on polyethylene. Among the items mentioned were shoe counters, guide step inserts, mid-soles, heel bases, and the firm's latest development, the polyethylene "Dutchman."

Tennessee Eastman Corp.'s John Marvin described "The Trend of Plastics into Ladies Shoe Heels," pointing out the advantages of acetate and butyrate in this application. In 15 years, plastics have graduated from bulky novelty items, which had to be cored-out to reduce weight, into today's streamlined, pencil-thin heels. This new type of heel can be fastened with equipment presently used for wooden heels.

SPE Rochester, N. Y.

An all-day seminar on plastics was held by SPE's Rochester Section, April 27, at the Sheraton Hotel, Rochester, N. Y. Registration came to 130, the majority of which came from the Rochester, Syracuse, Buffalo, Erie, and Toronto areas.

A hospitality room was taken for the night before, enabling the out-of-town guests to become acquainted with each other, and with the Rochester members. Technical sessions were held from 10:00 to 12:00 A.M., and from 2:00 to 4:00 P. M. Topics and speakers were as follows:

"Automatic Injection Molding," David Sloan, Lester-Phoenix Engineering Co.; "Molding Techniques, Fabrication, and End Uses for Expandable Polystyrene," Charles Snyder, Koppers Co., Inc.; "Nylon and Teflon in Fabricated and Extruded Forms—Whirlclad Finishing or Processing,"Ralph E. James, Polymer Corp.; "Extrusion of Thermoplastics—Is the Vented Cylinder Here to Stay?" Bruce Maddock, Bakelite Co.; "Tools and Materials for Thermosetting Molding," Edward Borro, Durez Plastics, division of Hooker Electrochemical Corp.; "Government Specifications for Plastics, and Plastics for Government," Waldo England, Eastman Kodak Co.; "What Today's Purchasing Agent Wants from Materials, Molders, and Fabricators," Peter White, Bausch & Lomb; "Plastics for Tools and Tools for Plastics—New Developments in the Field of Epoxy Resins," Burt Rosik, Eastman Kodak Co.; and "Coordination of Design and Manufacturing," Lawrence R. Martin, Eastman Kodak Co.

NEWS of the INDUSTRY

ND Polymer Symposium

A two-day symposium on recent advances in synthetic polymers will be held at the University of Notre Dame, Notre Dame, Ind., on July 16 and 17 under the sponsorship of W. R. Grace Chemical Research & Development Co. According to Dr. G. F. D'Alelio, head of the school's department of chemistry, the symposium will be open to the industry officials, university scientists, and technical leaders. The first day of the symposium will be devoted to lectures, while the second day will feature a panel discussion.

Scheduled to participate in the sessions are Prof. Giulio Natta, Instituto di Chemica Industriale del Politechnico, Milan, Italy; Prof. Charles Sadron, Centre de Recherches sur les Macromolecules, Strasbourg, France; Dr. W. B. Reynolds, Phillips Petroleum Co., Bartlesville, Okla.; Dr. A. P. Lien, Standard Oil Co. of Indiana, Whiting, Ind.; Prof. Herman Mark, Polytechnic Institute of Brooklyn, Brooklyn, N. Y.; and Dr. D'Alelio, who will serve as symposium chairman.

Further information on the symposium can be obtained from the University, and housing will be available on the campus and in the school's residence halls. For reservations, contact the Head, Department of Chemistry.

Commences Silicone Production

Several units of the new Silicones Division plant in Long Reach, W. Va., are now in operation, according to Union Carbide & Carbon Corp., New York, N. Y. Designed to meet the ever-increasing demands for silicones by industry, the new facility will eventually employ about 360 workers.

Silicone manufacture involves the production of monomers, intermediates, and finally the finished polymer. For this reason, the original plant at Tonawanda, N. Y., will continue in operation and research and product development activities will remain there.

Plans Baton Rouge Facility

Options on two tracts of land near Baton Rouge, La., have been exercised by Dow Chemical Co., and plans have already been formulated for chlorine, caustic soda, and organic chemical-producing facilities. Over $20-million will be invested in the operation, and it is estimated that 500 people will be employed.

Textileather Absorbs Forrest

Forrest Process & Development Corp., New York, N. Y., recently purchased by General Tire & Rubber Co., Akron, O., has been integrated into that firm's Textileather division. Present production facilities will remain in New York, and Edward Walton will remain as plant manager.

Forrest is known for duplication of material patterns in vinyl. Although its production had been largely restricted to handbags and novelties, plans are under way to expand into other industrial fields. Sales will be coordinated by Textileather, and specialized inquiries should be directed to the divisional office in Toledo, O.

Cyanamid Acquires Formica

The Formica Co., Cincinnati, O., has been acquired by American Cyanamid Co., New York, N. Y., and will operate as a wholly-owned subsidiary, designated the Formica Corp. Present management will be retained, and D. J. O'Conor, Jr., will continue to serve as president.

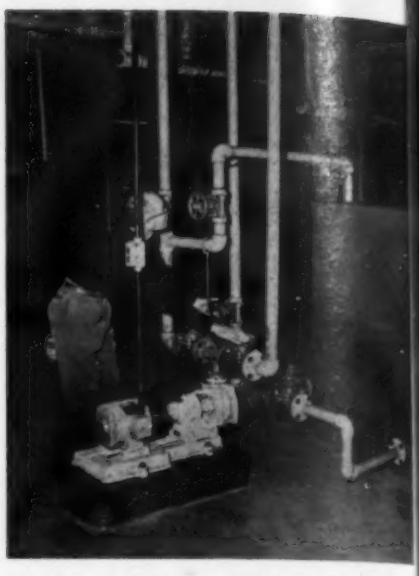
The acquisition brings together Cyanamid's broad research programs with Formica's extensive marketing organization, and is expected to increase both production and product distribution. The $2.5-million Formica plant expansion program at Evendale, O., is progressing on schedule, and will increase sheet laminating facilities by about 20%.

Formica's total product sales last year amounted to $36,471,588, with net earnings of $3,123,740. Cyanamid's totals for the same period totaled $451,088,434 and $38,712,666, respectively.

Buys Colt's Plastics Division

The plastics division of Colt's Mfg. Co., Hartford, Conn., has become a wholly-owned subsidiary of Penn-Texas Corp., and is now known as Manufactured Products Corp. Certain internal changes have been undertaken to provide a technical advisory service, and to better meet customer needs for plastic packaging products and industrial parts.

The physical plant is undergoing complete reorganization, and advanced manufacturing, materials handling, and quality control methods are being incorporated. The firm will produce standard and custom products ranging from jars, caps, and closures to industrial components. Complete services include hot stamping and screen process methods.



Chromic acid dilution tank served by 2-inch PVC piping.

New Use for PVC Pipe

Following extensive corrosion studies, Perfect Circle Corp., Hagerstown, Ind., has installed unplasticized PVC piping systems for chromic acid recovery and solution purification. Manufacturer of piston rings for the automotive industry, Perfect Circle had been troubled with scale formation, discoloration and other corrosive contaminations entailed in chromium plating operations.

Following extensive laboratory and field tests, the firm decided to adopt PVC piping supplied by Tube Turns Plastics, Inc., in five applications. Both 1¼- and 1½-inch lines were employed on the deionizer. The 1,500-gallon dilution tank, which contains 10-40% chromic acid was serviced with two-inch piping, as was the adapter tank. Two-inch lines were used to connect with the 350-gallon sulfuric acid-regenerant sump tank, and a 2½-inch line was employed for drainage of regeneration wastes. Operating temperatures range from 50-90° F., and pressures from 25-75 psi.

To Expand Plant Facilities

Plans have been announced by American Plastics Corp., New York, N. Y., for an additional 50% expansion of the plant area and production facilities of the Bainbridge, N. Y., plant. During the past eight months, this plant was expanded by more than 100% but the increased sales efforts of the company have necessitated an additional expansion.

The firm is a prime supplier of custom engineered, precision molded plastic parts for industrial end-uses, and has specialized in the molding of multiple-shot keys, bars, and knobs for typewriters, adding and calculating machines, radio and TV sets, and precision testing equipment. In addition, the company is a recognized supplier of reinforced-polyester moldings, all types of extrusions, formed products, individually designed plastic cartons, and plastic discs for the button and jewelry industries.

Schedules Formaldehyde Plant

Plans for the construction of a formaldehyde and synthetic resin plant in Fayetteville, N. C., have been announced by the chemical division of Borden Co., New York, N. Y. Scheduled for completion late in 1956, the facility will be geared to produce 36,000,000 pounds of formaldehyde yearly.

Added to the output of Borden's four existing formaldehyde plants, the company's total production will equal 12% of the total domestic consumption. These units are located at Kent, Wash., Springfield, Ore., Bainbridge, N. Y., and Demopolis, Ala.

A steel and concrete structure, the new plant will be fully automated and will employ about 25 local workers. Urea resins will be produced, and polyvinyl alcohol and acetate will be warehoused.

Plans Durez Plant Addition

A three-story addition to the Durez division plant at North Tonawanda, N. Y., is planned by Hooker Electrochemical Co., Niagara Falls, N. Y. Intended as a product application laboratory, the extension will connect with the present control laboratories, and will measure 50 by 120 feet.

Approximately $300,000 will be spent for the addition, and for equipment and repairs to the adjoining building. It will be of face brick extending to the street line.

Announces Trademark Change

Melamine molding compounds and resins produced by American Cyanamid Co.'s plastics & resins division, New York, N. Y., will now carry the trademark Cymel, according to a recent company announcement. The old designation, Melmac, will now refer only to melamine dinnerware molded from Cyanamid's resins and made according to Cyanamid quality standards.

Plans Texas Polyolefin Plant

A multi-million dollar plant for the manufacture of Fortiflex, a new polyolefin resin, is now in the planning stage, according to officials of Celanese Corp. of America's plastics division, Newark, N. J. Scheduled for completion during the first quarter of 1957, the facility will be located on a 220-acre site near Houston, Tex., and will have an annual capacity of nearly 40-million pounds.

Fortiflex reportedly has a number of advantages over other new polyethylenes, including better rigidity, higher temperature resistance, improved low temperature characteristics, and good dimensional stability. The material will be produced under license from Phillips Petroleum Co.

Enters Plastic Pipe Field

Still another pipe manufacturer is coming out with a line of rigid, unplasticized PVC pipe. The Alloy Tube division of Carpenter Steel Co., Union, N. J., producer of stainless steel tubing and pipe for over 28 years, is offering two types of PVC piping: a normal impact grade with high chemical resistance, and a high-impact grade with slightly less chemical resistance.

Designated Carpenter PVC No. 1 and No. 2, respectively, the lines are available with threaded and socket-type fittings. Both types of pipe are easily fabricated on standard metal and woodworking equipment, and can be formed, sawed, threaded, machined, hot gas-welded and solvent-cemented. The pipe is marketed in Schedules 40 and 80, in nominal sizes ranging from ½-4 inches. Ten- and 20-foot lengths with plain ends are standard.

Cyanamid Plant Expansion

An important expansion of its Fortier plant near New Orleans, La., has been announced by American Cyanamid Co., New York, N. Y. The first phase of this expansion is a monomethyl styrene plant that has just been completed and will soon be starting the production of chemicals to be used in new thermoplastic molding compounds having high heat resistance.

Final planning has been completed for the duplication of many existing facilities to double the plant's production of acrylonitrile, and this phase is scheduled for completion in 1958. Additional expansions of the plant are in the evaluation stage, and contemplate the large-scale production of acrylamide, an important new derivative of acrylonitrile.

The plant, begun early in the summer of 1952, was originally designed to permit doubling of production facilities. Completion of the acrylonitrile expansion will further consolidate Cyanamid's position as the leading producer of acrylonitrile, the key ingredient of such products as acrylic fibers, various plastics, and nitrile rubber.

Forms Two Sales Departments

Two sales departments have been formed by Emery Industries, Inc., Cincinnati, O., replacing the single chemical sales operation previously in existence. One group, called the organic chemical sales department, will handle the sales of all non-fatty Emery products. Included are azelaic and pelargonic acids, plasticizers, esters, diester lubricants, textile processing oils, and Twitchell emulsifying bases. This group will be headed by Robert F. Brown, who previously headed the chemical sales department.

The second group, the fatty acid sales department, will be under the direction of G. William Boyd, former sales manager of the Sanitone division. In addition to the standard fatty products (stearic and oleic), this group will handle animal and vegetable fatty acids, hydrogenated fatty acids, glycerides, and castor oil derivatives.

Doubles Opalon Production

New facilities which will more than double Monsanto Chemical Co.'s capacity to produce Opalon vinyl polymers and copolymers have been put into operation. Spurred by the fast-growing demands of the flooring, wire and cable, and paste resin markets, vinyl resin production should reach 600-million pounds in 1956, according to Monsanto sources. This represents a 20% increase over the 500-million pounds produced in 1955, which was an all-time high.

Plastic Firms to Cooperate

Two plastic firms, both engaged in the precision forming and fabrication of thermoplastic and fibrous glass-reinforced polyester sheeting, have signed a working agreement. Durable Formed Products, Inc., New York, N. Y., and Speck Plastics, Inc., Port Washington, N. Y., will coordinate their know-how, production facilities, sales service, product development facilities, and engineering research programs. Both companies will continue to function independently, and no attempt has been made to indicate financial integration.

St. Regis Announces Expansion

St. Regis Paper Co., New York, N. Y., has announced a doubled capacity for the Yonkers, N. Y., firms of Chester Packaging Products Corp., Cheslam Corp., and Chesflex Corp., a recently-acquired subsidiary and its affiliates. These companies produce unsupported polyethylene film for packaging, laminate and coat polyethylene to base materials, and extrude polyethylene pipe.

Basis for the expansion will be a new plant, which is presently under construction adjacent to the existing Chester facility. Production should be under way by late summer. Research facilities are also being expanded, and a number of new applications are under consideration.

UL Accepts Armored Cables

Armored cables with thermoplastic-insulated conductors (ACT), submitted by Columbia Cable & Electric Corp., Clifton Conduit, Inc., and Ettco Wire & Cable Corp., have been tested and found acceptable by Underwriters' Laboratories. Monsanto's Opalon 1028, a primary vinyl insulation compound, was used in all instances and found to meet the Type T requirements of the National Electrical Code.

Vinyl insulation strips are said to permit neater installations in junction boxes and, since the color is homogeneous, it cannot wear off and make identification a problem. Individual conductors are wrapped with 30-pound, wax-impregnated kraft paper applied with an overlap of about 50%. Each cable contains an aluminum bonding strip to prevent hot spots.

Plastics in Building Seminar

A two-week summer course devoted to the subject of "Plastics in Building" is being offered by Massachusetts Institute of Technology, Cambridge, Mass. Scheduled for July 2-13, the program will be devoted to the design of a small structure requiring the large-scale use of reinforced plastics.

In chronological order, the course will cover the principles of good design, including problems of acoustics, thermal controls, and space arrangement; a detailed consideration of the properties of reinforced plastics, and the various forms which are suitable for structural purposes; and the consideration of specific design variations.

Classes will meet Mondays through Fridays, with the exception of July 4, from 9:30-12:00 a.m. and from 1:00 to 4:30 p.m. Tuition is $180, payable on notification of admission. Academic credit is not offered.

Finds Peracetic Acid Process

A new process for making peracetic acid from acetaldehyde was announced by H. B. McClure, president of Carbide & Carbon Chemicals Co., New York, N. Y., at a press conference in New York City's Plaza Hotel, April 9. After five years of intensive research, a commercially-feasible process was developed for producing this promising chemical in volume. To date, more than 375 epoxides have been made from this compound at Carbide's research center in Charleston, W. Va., and still more are under investigation.

It is believed that these products will find use in the manufacture of plasticizers, resins, coatings, surfactants, pharmaceuticals, and odorants. As other derivatives are offered, the uses for peracetic acid are expected to broaden appreciably.

Effects Corporate Name Change

A new company, Trinity Products, Inc., has been organized to absorb and, in effect, change the operating name of Texas Plastic Development Corp., Trinity, Tex. Flex Flume irrigation tubing has been accepted on a nation-wide basis, and it was felt that the old name was both unwieldy and too regional in nature.

Officers for the new corporation were announced as follows: William P. Allen, president; C. J. Gerker, vice president in charge of sales; and William T. Epperson, general manager. General offices remain in Trinity, Tex., and sales offices in Houston.

Grace Sets Up Plastics Lab

The headquarters and applications laboratories of the newly-formed polymer chemicals division of W. R. Grace & Co., New York, N. Y., will be located in Clifton, N. J. A recently acquired, one-story

New headquarters and applications laboratories in Clifton, N. J., of W. R. Grace's polymer chemicals division.

modern building will house the divisions laboratories, its management staff, its eastern regional sales headquarters, and its New York area sales organization. The 47,000-square foot structure is situated on a four-acre tract of land.

The applications laboratories are being equipped with a wide range of typical machinery used for plastics molding, extrusion, wire coating, printing, embossing, and fabricating, together with apparatus needed to test the company's Grex polyolefin resins. The division will conduct much of its chemical research and development work at Clifton, including the formulation of tailor-made resins to meet specific needs.

Establishes Sheet Standards

A new standard covering reinforced plastic sheet laminates for mechanical and electrical applications has been adopted by the National Electrical Mfgrs. Assn., American Society of Testing Materials, and The Society of the Plastics Industry, Inc. Included in this category are general-purpose grades of polyester glass-mat sheet laminates.

This GPO-1 standard was originally drawn up by a joint NEMA-SPI committee after consultation with the principal manufacturers involved, and follows the existing NEMA standards for phenolic and melamine sheets. Control values for essential physical and electrical properties at elevated temperatures, as required of Class B electrical insulation, are specified.

Expands School-Aid Program

An expanded program for financial aid to scientific education during the 1956-57 school year has been announced by Monsanto Chemical Co., St. Louis, Mo. A total of 83 colleges and universities will benefit from 111 separate direct-aid awards, an increase of 30 and 39, respectively, over last year.

These awards include 29 fellowships, 41 undergraduate scholarships, and 41 cash grants. Fellowships average $3,000 in value, and the scholarships cover tuition costs. Monsanto retains no control over their issuance, and choice is made by school officials on the basis of merit and need. The cash grants may be used at the schools' discretion to finance research, purchase equipment, or otherwise further scientific purposes.

In Brief . . .

Larvacide Products, Inc., New York, N. Y., has announced the availability of heavy-duty vinyl tarpaulins for a variety of horticultural and agricultural uses. Vinyl material used in the tarpaulins is Ultron, a product of Monsanto Chemical Co.'s plastics division.

Rohm & Haas Co., Philadelphia, Pa., has filed suit against General Mills, Inc., seeking a judgement of invalidity for General Mills' patent No. 2,559,177, which covers vinyl ester compositions plasticized with certain epoxidized esters.

Panelyte Division, St. Regis Paper Co., New York, N. Y., has assembled a sales book on plastics which makes extensive use of plastic overlays and dividers; an example of using plastics to sell plastics.

The Rubber Manufacturers Association, New York, N. Y., has expanded its activities to include manufacturers of vinyl floorings. This group will become part of the RMA Flooring Division.

E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., will feature Mylar at the National Packaging Exposition, which will be held in Atlantic City, April 9-12. Highlighting the exhibit will be a special demonstration of high-speed wrapping on automatic equipment.

Reed-Prentice Corp., Worcester, Mass., has opened a new sales office at 1846 Owendale Drive, Dayton 9, Ohio. Eric Brierley will direct the operation.

Hydraulic Press Mfg. Co., Mount Gilead, O., has announced a change in address for its Chicago area branch office to 911 Busse Highway, Park Ridge, Ill.

J. M. Huber Corp., New York, N. Y., has formed a sales division, the general industries division, for the merchandising of Huber clays, carbon blacks, special pigments, and conditioners to the plastics, flooring adhesives, paint, ink, ceramics, pesticide, and food industries.

General Tire & Rubber Co.'s Textileather division, Toledo, O., has added three new patterns to the Nygen Tolex line of coated fabrics. Two are deeply embossed tweeds, and the third gives a natural grass fiber effect. Patent No. 618,754 has been granted for the Nygen Tolex name.

NOW . . . FASTER DELIVERIES !

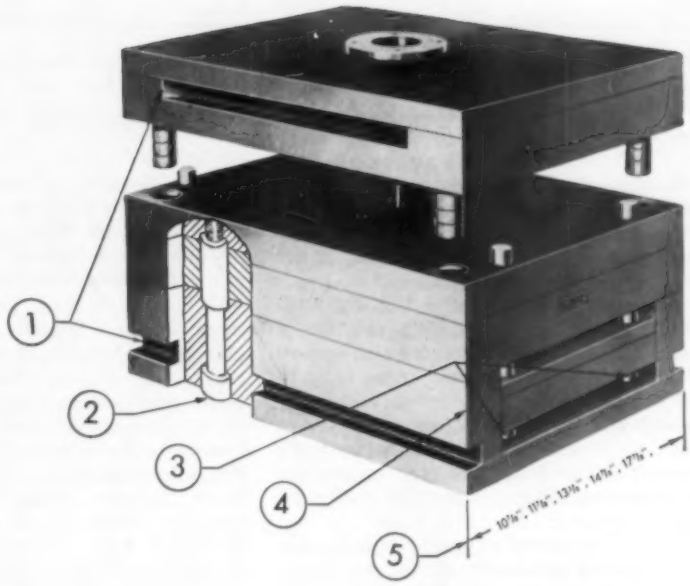
ON D-M-E STANDARD MOLD BASES!

EXPANDED FACILITIES SAVE YOU TIME . . !

Now . . . you can get FASTER DELIVERIES on the highest quality Standard Mold Bases even though the demand has reached an all time high!

This availability has been made possible by the recent expansion in D-M-E's manufacturing facilities. With D-M-E's Hillside, New Jersey plant doubled and additions at the Detroit, Michigan plant completed, production of Standard Mold Bases is now geared to meet the ever-increasing demands of the Industry.

This increased production has enabled D-M-E's FIVE BRANCH WAREHOUSES to replenish their stocks and provide IMMEDIATE DELIVERIES on a wide range of standard sizes . . . This means ADDED SAVINGS in mold construction time as well as ECONOMY in mold costs for you!



(9" wide series available with clamping ledges and solid dowels.)

4,400 COMBINATIONS SAVE YOU MONEY . . !

22 Standard Width and Length combinations . . .
From 9" x 8" to 17⅞" x 35½"

100 Cavity Plate Combinations . . .
From ⅞" thick to 5⅞" thick

2 Special Types of Steel . . .

DME No. 1 Steel —
Medium Carbon, silicon killed

DME No. 2 Steel —
SAE 6145, electric furnace grade, preheat treated to 225 Brinell.

For complete data and prices . . .
CONSULT YOUR NEW D-M-E CATALOG!

YOU GET TOP QUALITY PLUS THESE ADDED FEATURES!

1. **CLAMP SLOTS to Save Platen Space**
   Eliminates space-wasting "clamping ledges"
2. **MORE ROOM for Waterlines**
   Tubular Dowels eliminate obstruction
3. **STOP PINS WELDED to Ejector Bar**
   Prevents loosening and ejection interference
4. **RIGID CONSTRUCTION with Less Parts**
   One piece Ejector Housing gives added strength
5. **NEW WIDTHS Fit More Molding Machines**
   Allows more cavities to existing platen area

CONTACT YOUR NEAREST D-M-E BRANCH . . . TODAY!

DETROIT MOLD ENGINEERING CO.

6686 E. McNICHOLS ROAD — DETROIT 12, MICHIGAN — TWinbrook 1-1300

Contact Your Nearest Branch FOR FASTER DELIVERIES!

HILLSIDE, N. J. (NEAR NEWARK) 1217 CENTRAL AVE., ELIZABETH 3-5840
CHICAGO 51, ILLINOIS 5901 W. DIVISION STREET, COLUMBUS 1-7855
CLEVELAND 9, O. - D-M-E CORP. 502 BROOKPARK RD., SHADYSIDE 1-9202
LOS ANGELES 7, CAL. 3700 SOUTH MAIN STREET, ADAMS 3-8214

D-M-E MASTER LAYOUTS are available for each of the 22 different Standard Mold Bases sizes! See Page 164 of your D-M-E Catalog for complete ordering information.

News from Abroad

Russia to Emphasize Plastics in Consumer Goods

Russian plastics processors, hitherto primarily concerned with meeting the needs of Soviet industry and the military, have been ordered to pay more attention to the growing consumer market.

Directives issued for the USSR's Sixth Five Year Plan (1956-1960) call for a sharp increase in both volume and variety of existing plastic household items. In addition, with metals still in short supply throughout the Soviet economy, Russian research institutes are under heavy pressure to find new applications for plastics in everything from automobile bodies to book bindings.

Russia's Ministry of Trade reports that retail sales of plastic articles jumped more than six-fold during the Fifth Five Year Plan (1951-1955). It claims that "Soviet industry is now able to supply all civilian demands for plastics."

At the same time, the ministry frankly admits that consumers would have bought far more plastic items were it not for "serious deficiencies" in their manufacture and distribution. Premier Bulganin, in a recent speech, took special notice of the situation by demanding that the Ministry of the Chemical Industry "supply the national economy with a new assortment of plastic products." In an earlier address, Bulganin charged that "the Ministry of the Chemical Industry is too slow in developing new types of plastics."

Plastics have already taken over a few Russian products almost entirely. These include safety razors, soap dishes, toothbrushes, and cases for eyeglasses. Plastics are also used in the USSR for making dishes, buttons, drinking glasses and cups, ash trays, raincoats, fancy knick-knack boxes, powder boxes, radio cabinets, hairbrushes, toys, combs, tablecloths, and automobile steering wheels.

However, many simple plastic items readily available in the United States cannot be found in Soviet stores for long periods of time, if at all. The USSR Ministry of Trade, which is responsible for selling consumer goods, has a current price list covering more than 200 varieties of plastic articles. But the USSR Ministry of the Chemical Industry, which makes these items, includes only 40 types of plastic goods in its catalog. "In most stores," the Ministry of Trade complains, "plastic fine-tooth combs, children's combs, shoehorns, thimbles, glass holders, salt and pepper shakers, spice boxes, collars, etc., cannot be found.

"The principal reason for this abnormal state of affairs is that the plastics processors, in setting up their production program, include only the simplest and most profitable items. Thus, a minimum number of unprofitable eyeglass cases is turned out at the same time the market is flooded with profitable soap dishes and cigarette cases. Characteristically, almost all of the Ministry of the Chemical Industry's plants make soap dishes. With few exceptions these establishments are also capable of manufacturing household containers of 1-2 liters capacity which are in great demand. But only three or four plants do this work. Some factories make large numbers of profitable celluloid and polystyrene combs of certain types while absolutely refusing to make other types of plastic combs that are harder to manufacture."

The trade ministry said that 48% of one Soviet plastics manufacturer's 1955 output consisted of soap dishes and cigarette cases. Not one Russian plant produced plastic shoe horns despite the large demand for them. "Customers frequently are astonished," the Russian agency went on, "to find that all the plastic items on a store's shelves are of the same color. This is because the factories work on one color for a specified period, and then change to another. The warehouses are supposed to sort the goods so that each store will get a given item in a minimum of four or five colors. They often fail to do this."

Poor geographical organization of plastic products manufacture continues despite government efforts at overall master planning. Soviet officials deplore the fact that Moscow and Leningrad import some plastic items from factories a thousand or miles away in Siberia or the trans-Caucasus. Meanwhile, plastic thimbles bought in Siberia and the trans-Caucasus are shipped in from Moscow. "There is no reason whatever why these items cannot be made locally," the trade ministry declared. It also pointed out that careless packaging of plastic articles shipped long distances has resulted in heavy losses through damage.

The Russians have been struggling for a number of years to increase the variety of plastic products available to consumers with only modest success. In 1954 and 1955, the Ministry of the Chemical Industry was supposed to "master the production" of 70 new items. It actually turned out only 15 of these, including curtain rings, frames for looking glasses, and bags of polyethylene film. Some of the "new" items were actually only variations of products already being manufactured.

The Soviet press has commented that when Russian plastics makers exhibit their latest designs, many of the items from different factories look exactly alike. "Our industry could also make plastic articles with finishes resembling amber, walnut, malachite and redwood," the magazine *Ogonyok* declared. "Unfortunately," it added, "this possibility is ignored."

The trade ministry noted that introduction of new plastic products frequently requires the cooperation of other branches of Soviet industry. In many cases, this cooperation is not forthcoming. For example, plans were made to produce new kinds of plastic boxes with hinged lids. The small hinge manufacturers, responsible to a different ministry, failed to supply the necessary parts.

The magazine *Sovyetskaya Torgovlya* (Soviet Trade) sees a potentially-large market for plastics in souvenir manufacturing, which received little attention under the austere Stalin regime. Now, with the Russian population itself doing more pleasure traveling and with thousands of visitors entering the USSR from both the satellites and the West, Soviet souvenir sales could be booming. "Small articles such as notebooks, figurines, and models of historical buildings are ideally suited to plastics," *Sovyetskaya Torgovlya* observed. "It is a pity that the Ministry of the Chemical Industry does not make such things."

The Ministry of Trade has already taken steps to promote the sale of plastic products through better merchandising methods. It has ordered its large department stores to establish special sections featuring plastic goods. One small retail store specializing in plastic products is now operating in Moscow. The trade ministry says similar shops should be opened in the capitals of all the union republics.

Managers of retail establishments have been advised to display and advertise their plastic goods more effectively to the public, and to keep pressing wholesalers and manufacturers for a wider variety of items. Trade organizations are being told to start exercising their right to change the make-up of previously placed wholesale orders to keep abreast of changing retail demands.

Plastics Meeting in Munich

The Plastics and Rubber Section of the Society of German Chemists held a meeting on September 14, 1955, in Munich, Germany. Four papers were read, the number purposely having been kept low to permit adequate treatment of topics selected and for subsequent discussions.

The papers were: "Lignin as a Polymeric Natural Substance," by K. Freudenberg; "The Mulheim Normal Pressure Polythene Process," by K. Ziegler; "Application of Infrared Spectroscopy in the Field of High Molecular Substances," by W. Brugel; and "Esters of Monofunctional Alcohols as Plasticizers for PVC," by F. Wurstlen.

The first two papers were also presented at the general meeting of the Society, and a lecture-hall crowded to capacity testified to the interest they aroused.

NAMES in the NEWS

Howard Smith

Howard Smith has been appointed assistant general sales manager of Bakelite Co., New York, N. Y., where he will have the primary responsibility of pricing materials and administering contracts. He joined Union Carbide's plastics division in 1925 as a technical representative; served as district manager and divisional manager of the varnish resins division; and was formerly manager of the industrial products department.

Mrs. Dorothy M. Gundlach has been appointed color consultant on molding compounds for the plastics and resins division of American Cyanamid Co., New York, N. Y. A newly-created position, the consulting activity includes technical and advisory service on color in relation to the firm's molding compounds.

George H. Melvin has been named regional sales manager, with headquarters in Charlotte, N. C., for the plastics and resins division of American Cyanamid Co., New York, N. Y. Holder of a bachelor's degree in chemical engineering, **Mr. Melvin** has been associated with the division for the past nine years as a senior technical representative in the southeastern region.

Charles May Studios

D. F. Behney

D. F. Behney, James L. Weaver, Jr., and **William L. Lasser** have been elected directors of Harwick Standard Chemical Co., Akron, O. In addition, **Mr. Behney** was named to the newly-created post of vice president in charge of sales. **Mr. Behney** has been with the company since 1950, becoming general sales manager in 1951. **Messrs. Weaver** and **Lasser** have been with Harwick Standard since 1947 and 1951, respectively.

Robert S. Holdsworth has been added to the research division staff of National Research Corp., Cambridge, Mass., as a group leader in the petrochemicals research department. He will be engaged in research on polymerization; a portion of the program operated by the firm for Escambia Bay Chemical Corp. **Mr. Holdsworth** was previously with the Naugatuck Chemical Division, United States Rubber Co.

George J. Miller has become an applications engineer for the customer service laboratory of Houghton Laboratories, Inc., Olean, N. Y. He previously served for five years with General Electric Co., and in 1955 received the manufacturing award for work in plastic tooling.

Forrest E. Phillips has been promoted to sales manager of the phenolic molding compound department of Synvar Corp., Wilmington, Del. He joined the company in 1954 after having served as superintendent of the molding and rubber departments of S. S. White Co., general manager of Northeastern Molding Co., and as project engineer for Delaware Chemicals, Inc.

W. F. Twombly, vice president of Witco Chemical Co., New York, N. Y., has taken a temporary appointment as consultant on organic chemicals in the Chemical & Rubber Division of the Business and Defense Services Administration, Department of Commerce. During his absence from Witco, his duties will be assumed by **William C. Walker,** assistant director of advertising and public relations.

Roy D. Perdue, Jr., and **Joseph H. Murphy** have been appointed to the technical staff of National Polychemicals, Inc., Wilmington, Del. **Mr. Perdue,** formerly with the Springfield Armory, Barrett Division of Allied Chemical & Dye Corp., and Baker Castor Oil Co., will be a project engineer. Previously with Esso Research & Development Co., **Mr. Murphy** has joined National Polychemicals' research and development group.

James A. Melchore has been appointed senior technical sales representative for thermoplastic molding compounds manufactured by American Cyanamid Co.'s plastics & resins division, New York, N. Y. A chemist, **Mr. Melchore** has been associated with Cyanamid since 1944, and has served as group leader at the Stamford Laboratory since 1953.

E. L. Kropscott

Earle L. Kropscott has been promoted to staff manager of molding materials for the plastics department, Dow Chemical Co., Midland, Mich. Since 1946, he had been assistant manager of Dow's plastics technical service. In his new position, **Dr. Kropscott** will be responsible for long-range planning for molding materials. He joined Dow in 1937, working in the cellulose products section; became head of the plastics laboratory of this section in 1939; and transferred to plastics technical service in 1946, where he was largely concerned with developing new materials and fabricating techniques.

Dr. John S. Young has been appointed automotive industry specialist for the plastics sales section of E. I. du Pont de Nemours & Co., Inc., Wilmington, Del. He has been with the company's Polychemical Department sales office in Detroit for the past three years. In his new post, **Dr. Young** will head Du Pont's development work on new uses for plastics in automobiles.

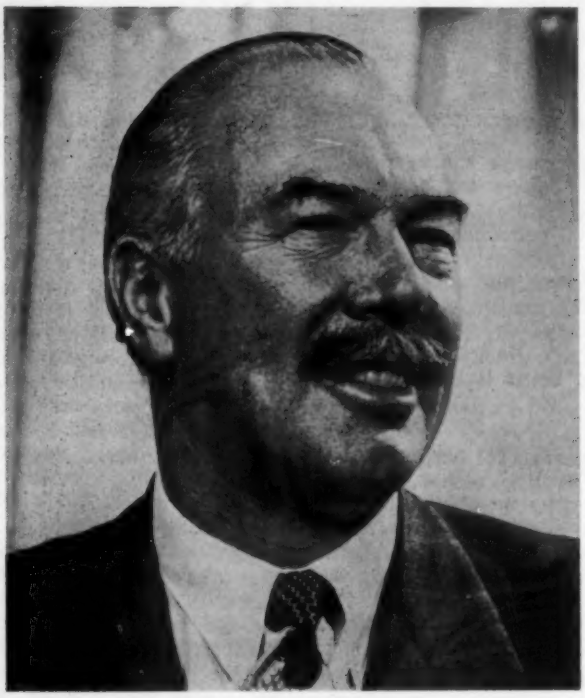
Swoger Studio

Carlyle W. Gilbert

Carlyle W. Gilbert has been named manager of the resins and plastics department, chemical plants division, Blaw-Knox Co., Pittsburgh, Pa. He previously served with Shell Oil Co., and with Firestone Tire & Rubber Co. in that company's resin development department.

Walter F. Comstock has been appointed manager of the new regional sales office in Kansas City for the Corrulux Division, L-O-F Glass Fibers Co., Houston, Tex. This new office will handle sales in North Dakota, South Dakota, Nebraska, Kansas, Minnesota, and parts of Wisconsin, Iowa, and Missouri. **Mr. Comstock** has been with Kaiser Aluminum & Chemical Sales, Haskins & Sells, and Long-Bell Lumber Co.

James M. Veeder former assistant manager of Koppers Co., Inc.'s finance department, Pittsburgh Pa. has been named vice president and manager of that department. He replaces **E. A. Barry,** who has been appointed assistant to the president. **Charles G. Strang** has been named vice president, and will take over **Mr. Veeder's** former duties as assistant manager.



EDWARD LYMAN BILL

Edward Lyman Bill, president of Bill Brothers Publishing Corporation, an officer and director in all of its affiliated publishing companies, and co-publisher of PLASTICS TECHNOLOGY since its founding, died on April 22, 1956 in Capetown, Union of South Africa.

Mr. Bill was widely known in the business publication field, being a founder of the Business Publication Audit of Circulation, Inc., and a former director of National Business Publications, Inc.

Educated at the University of Wisconsin and Columbia University, he served in World War I with the American Ambulance Field Service, French aviation and the Foreign Legion, then as an officer in the French artillery and French cavalry.

Mr. Bill spent most of his life in business paper publishing. His long and varied experience ranged from a stock boy through field reporter, circulation roadman, space salesman, business manager, editor, publisher, and corporate executive. Through this experience, he developed his understanding of people at all levels, and versatility in grasping the fundamentals of the various fields served by the Bill Brothers publications.

He was widely known as the founder president of Bonnie Briar Country Club, Larchmont, N. Y.; as a former president of the Adventurers Club; and as organizer president of the Cracker Barrel. He was a yachtsman, clubman, connoisseur of antiques, dairy farmer, member of the Bartenders Union and the American Ordnance Association, and an official of the State Police.

Mr. Bill is survived by a daughter, a sister, his brother Raymond Bill, and two grandchildren.

Names in the News (Cont'd.)

Donald L. Fuller has been appointed director of research for Grace Chemical Research & Development Co., division of W. R. Grace & Co. **Dr. Fuller** came to Grace from American Cyanamid, where he had been serving as technical director of the firm's petrochemical plant in New Orleans.

Alexander G. Koos has joined the plastics division of Celanese Corp. of America, New York, N. Y., as a member of its sales development department staff. He was formerly associated with Diamond Alkali Co. and the Virginia-Carolina Chemical Corp.

William T. Smith has been assigned to the New York sales office of Goodyear Tire & Rubber Co.'s chemical division. He has been performing sales service work with the coatings department for the past 14 months.

Robert P. Parker has been appointed assistant general manager of American Cyanamid Co.'s research division. He has been serving as director of research at the Pearl River Laboratories since 1954.

R. F. Brown has been appointed manager of Emery Industries, Inc.'s new organic chemical sales department, Cincinnati, O. R. T. Hull and V. W. Colby have been named assistant sales managers.

Ralph F. Nickerson has been transferred from the research department of Monsanto Chemical Co.'s inorganic chemicals division to the Shawinigan Resins Corp., Springfield, Mass. Dr. Nickerson had been group leader for silica products at the Everett, Mass., plant.

Charles J. Beringer has been appointed Mid-West representative for Plastics Color Co., Summit, N. J. He was formerly associated with Kohnstamm & Co., in the Chicago area.

Laurence J. Ackerman, dean of University of Connecticut's School of Business Administration, and Bernard Flaxman, vice president of Hartford Fire Insurance Co., have been elected directors of Rogers Corp., Rogers, Conn. The firm produces non-metallic specialty materials and impact plastics.

J. William McCrackin, a general manufacturing superintendent at the **John F. Queeny** plant of Monsanto Chemical Co., St. Louis, Mo., has joined Mobay Chemical Co., also of St. Louis, as a technical service representative. In his initial assignment, he will work with the customer service group in Mobay's research and demonstration laboratories. Holder of a B.S. in chemical engineering, **Mr. McCrackin** joined Monsanto in 1936.

New Materials

Write item numbers on Readers' Service Card to obtain more information.

Plasticizer Intermediate

A single-distilled oleic acid, Emersol 213 Low Titer Elaine, has been added to the line of fatty acids and derivatives produced by Emery Industries, Inc., Carew Tower, Cincinnati 2, O. Lighter in color than the standard Emersol 211, the material shows the following physical properties:

Titer, °C.	5.0
Iodine value, Wijs	91-95
Acid value, mg. KOH/gm.	193-201
Free fatty acid content, % oleic	97-101
Saponification value, mg. KOH/gm.	195-203
Color, 1-in. Lovibond	5y/1R-10y/2R
Unsaponifiable material, % max.	2.5

Readers' Service Item M-1

Molybdenum-Filled Nylon

A molybdenum disulfide-filled nylon molding powder, said to possess superior wear and frictional properties, has been introduced by National Polymer Products, Inc., 125 North Fourth St., Reading, Pa. Designated Nylatron GS, the material is a dark grey formulation said to be similar but superior to nylon 101.

A comparison of properties for the two materials is given in the following table:

	Nylatron GS	Nylon 101
Tensile strength @ 77°F., psi.	12,000-15,000	11,000
Modulus of elasticity @ 77°F., psi.	598,750	400,000
Flexural strength @ 77°F., psi.	19,250	13,800
Hardness, Rockwell M.	89	90
Impact strength, Izod, 73°F., ft.lb./in.	0.62	0.94
Heat distortion temperature @ 264 psi., °F.	251	200
Coefficient of linear expansion/°F., x 10⁻⁵	2.3	5.5
Dielectric strength, short time, volts/mil	356	385
Specific gravity	1.14	1.14
Water absorption, %	1.5	1.5
Flammability, both materials	Self-extinguishing	

Readers' Service Item M-2

Two PVC Plasticizers

Two new plasticizers, one a mixture of decyl esters and the other a modified DIDP, have been introduced by Rubber Corp. of America, Hicksville, L. I., N. Y. Designated RC Plasticizers D-31 and DIDP-10, respectively, both materials find application in PVC formulations.

RC Plasticizer D-31 is a premium blend of DIDP and DIDA, and functions as a low-temperature plasticizer with excellent over-all performance. Low volatility, heat stability, and reduced water sensitivity are other features of the material.

RC Plasticizer DIDP-10 was designed to improve low-temperature brittle points PVC compounds, while maintaining the low volatility characteristics of the higher phthalate esters. Excellent aging characteristics, resistance to extraction by soapy water, and low specific gravity are also claimed for the material. Its use is indicated in films, hose, floor tile, plastisols, outerwear, and upholstery.

Typical properties are quoted as follows:

	D-31	DIDP-10
Molecular weight, average	441	438
Color, maximum APHA	100	100
Odor	Mild	Mild
Specific gravity, 20/20° C	0.949-0.959	0.95-0.96
Acidity, max. as acetic acid, %	0.01	0.01
Moisture, max. %	0.05	0.05
Mid-boiling point @ 5 mm., °C	253	259
Flash point, °F	420	425
Viscosity @ 25°C., cps	64	73
Surface tension @ 25°C., dynes/cm.	32	33
Saponification number	254	241
Acid number	0.03	0.04
Ash content	None	None
Weight, lbs./gal.	7.95	7.96
Solubility in water, 25°C	Insoluble	Insoluble
Water solubility in plasticizer, %	0.1	0.1

Readers' Service Item M-3

Polyurethane-Alkyd Component

Pure-grade flake trimethylolpropane, a chemical used in the production of polyurethanes, alkyds, synthetic drying oils, plasticizers, polyesters, and surfactants, has been introduced commercially by the chemical division of Celanese Corp. of America, 180 Madison Ave., New York 16, N. Y. An aldol, the material is said to impart better adhesion, color retention, and hardness to alkyd-base baking enamels.

Property data are quoted as follows:

Water content, % max.	0.05
Color, APHA	5
Melting point, °C	55-59
Hydroxyl content, % min.	37.5
Formic acid content, % max.	0.002

Readers' Service Item M-4

Polymerizable Allyl Monomer

Triallyl citrate a highly-unsaturated, reactive monomer, has been introduced commercially by Chas. Pfizer & Co., Inc., 630 Flushing Ave., Brooklyn 6, N. Y. Essentially a cross-linking agent for polyester resins, the material can be polymerized to hard, brittle thermoset compounds.

Triallyl citrate is immiscible with water, and miscible with acetone, benzene, chloroform, dioxane, ethanol, and glacial acetic acid. Its empirical formula is $C_{15}H_{20}O_7$. Other properties are listed as follows:

Refractive index	1.471
Specific gravity	1.144
Boiling point, °C	143
Hydroquinone content, %	0.01

Readers' Service Item M-5

Low-Melting Solid Plasticizer

Monsanto Chemical Co.'s organic chemicals division, 800 North 12th Blvd., St. Louis 1, Mo., has announced the introduction of cyclohexyl diphenyl phosphate, a low-melting plasticizer for cellulose nitrate and cellulose acetate. In these resins, the material reportedly improves adhesion, clarity, gloss, and resistance to oil and water. It provides PVC formulations which are moderately flexible, flame-retardant, and resistant to oil and water extraction.

Yet another use for cyclohexyl diphenyl phosphate involves resin adhesives, where

it is highly compatible and produces emulsions with excellent tack. Typical inspection data are reported as follows:

Acidity, meq/100 gms	0.02
Color of melt, APHA	30
Melting point, °C	39-40
Moisture content, %	0.05
Refractive index @ 25° C	1.5345
Specific gravity	1.1802

Readers' Service Item M-6

Polyurethane Prepolymer

A polyurethane prepolymer for resilient, water-absorbent foams has been introduced by Thiokol Chemical Corp., 780 North Clinton Ave., Trenton 7, N. J. Designated ZL-239, the material reportedly can be processed into foams whose water-absorbency values range to 1,200% by weight.

ZL-239 is packaged as a three-component mix; emulsifier, prepolymer, and catalyst. Three-month storage under ambient conditions reveals no change in viscosity or foaming performance. Best results are obtained by adding emulsifier to prepolymer; blending until uniform; adding catalyst at 27° C.; stirring until foaming begins; and pouring the material into waxed molds. The foam is allowed to cure ½-hour at room temperature, followed by one hour at 70° C.

The density obtained by this method is 4.5 pounds per cubic foot; however, lower-density foams can be made by small variations in the water content of the catalyst component. Material and finished-foam properties are reported as follows:

Viscosity @ 80° F., poises	60
Specific gravity	1.200
Color	amber
Tensile strength, dry, psi	22
Wet, psi	11
Elongation, dry, %	300
Wet, %	175
Water absorbency, %	1,200

Readers' Service Item M-7

new RC plasticizer

D-31

economical, top-quality replacement for N-ODP now available!

The result of exhaustive laboratory development, RC Plasticizer D-31 is available now as a low cost replacement for N-ODP. This new product has comparable physical properties, brittle point and efficiency, but with *much lower volatility* and *soapy water extraction.*

COMPARISON PROVES LOW-COST D-31 IS BETTER . . .

	N-ODP	RC D-31
Polyvinyl chloride	100	100
Plasticizer	50	50
Plumbosil B	3	3
Stearic Acid	1	1
Tensile, psi	2680	2750
100% Modulus, psi	1500	1520
Elongation, %	305	330
SPI Volatility	−0.9	−0.6
SPI Brittlepoint		
Passed, °C.	−25	−25
Failed, °C.	−30	−30
Soapy Water Extraction	%−0.3	+0.2
Oil Extraction	%−6.5	−7.4

Ready . . . reliable . . . RC serving American industry, since 1930

WRITE TODAY! Ask for our technical data sheet on new D-31. We'll be glad to send you samples!

RUBBER CORPORATION OF AMERICA
New South Road, Hicksville, N. Y.
Sales Offices: NEW YORK • AKRON • CHICAGO • BOSTON

Four Epoxy Compounds

A series of four epoxy resins designed primarily for corrosion-resistant surface coatings has been introduced by Bakelite Co., 30 East 42nd St., New York 17, N. Y. EKRA-2053 in a solid, friable, pale-amber resin which undergoes esterification with vegetable oil acids to provide highly-adhesive, chemically and impact-resistant coatings. It can be applied to a variety of surfaces by brushing, spraying, dip-coating, roller, or flow coating.

EKRD-2003 is identical with 2053, except that in short-oil varnishes it yields vehicles of somewhat higher viscosity for the same solids content and cooking time. Properties for the two resins are reported as follows:

Ash content, %	0.03
Clarity	Crystal
Color, Gardner 1933	6
Epoxide equivalent	875-975
Esterification equivalent, approx.	175
Softening point, °F	198-218
Specific gravity	1.19
Viscosity, Gardner standard	Q-U

EKRA-2002 resembles the other two resins in appearance, but is designed to react with curing agents and hardeners such as amines, polyamides, and urea-formaldehyde resins. It can be esterified, and will undergo the reactions common to epoxies. Property data is quoted as follows:

Softening point, °F	145-170
Epoxide equivalent	450-525
Ash content, %	0.03
Viscosity, Gardner-Holdt	C-G
Color, Gardner 1933	6
Specific gravity	1.17
Esterification equivalent approx.	145
Clarity	Crystal

EKSA-2002 is the same material as EKRA-2002 in the form of a 75% solution in toluene, and the following properties are noted.

Epoxide equivalent	600-700
Viscosity, cks	3,500-5,000
Density, lbs./gal.	9.1
Non-volatile, %	73-77
Ash content, %	0.03
Color, Gardner 1933	6
Clarity	Crystal

Readers' Service Item M-8

Silicone-Modified Rubber

Stoner Rubber Co., Inc., 7061 E. Monroe St., Anaheim, Calif., is offering Composition M-1, a silicone-modified butadene-acrylonitrile rubber for mold parts, liners, blankets, and bags used in the cure of plastic laminates at elevated temperatures. Calendered membrane is available as 18-mil cured, 35-mil uncured, and milled sheet stock.

The uncured membrane may be tailored to specific shape before cure, preferably using pressures up to 100 psi. Cured membranes offer an initial elongation of 900%, 335% after 70 hours at 300° F., and 340% after eight hours at 400° F.

As a blanket for sandwich laminates, the material is said to eliminate leaks with subsequent spoilage. Over 100 hours of reusability at normal curing temperatures have been reported. Specific gravity is reported to be 1.16-1.36, and the weight of 18-mil sheeting is approximately 1.1 pounds per square yard. Other property data is listed as follows:

	Unaged	48 hrs. @ 300° F	70 hrs. @ 300° F
Tensile stress (modulus) psi:			
At 100% elongation	120	325	440
At 200% elongation	175	595	1.050
At 300% elongation	250	1.065	1.810
Tensile strength, psi	2.800	2.445	2.280
Elongation, %	900	585	335
Shore creep	78-68	84-81	88-86

Readers' Service Item M-9

Chlorofluorocarbon Materials

Four chlorofluorocarbons are being offered in pilot-plant quantities by Hooker Electrochemical Co., 1940 Ward St., Niagara Falls, N. Y. Based on hexachlorobutadiene and hexachlorocyclopentadiene, the materials are 2,3-dichlorohexafluorobutene-2, 1,2-dichlorohexafluorocyclopentene-1, 2,2,3,3-tetrachlorohexafluorobutane, and 2,2,3-trichloroheptafluorobutane.

The first-mentioned material serves as an intermediate for preparing such compounds as chlorofluorocarbons, perfluorocarbons, and fluorinated monomers. The pentene material contains a double bond which permits high fluoridation. Oxidation produces an intermediate which, in turn, can be used in the preparation of polyesters and polyamides. Both butane materials can be used to prepare dielectrics.

Taking the materials and giving them the arbitrary designations of No. 1, 2, 3, and 4, based on the order in which they appear in the first paragraph, the following properties are reported:

	No. 1	No. 2	No. 3	No. 4
Molecular weight	232.96	244.97	303.88	287.42
Boiling point, °C.	67	90	133	98
Freezing point, °C.	—67.3	—69.3	83	0
Density @ 20°C., gm./cc.	1.6191	1.6507	1.64	1.75
Weight, lbs./gal.	13.5	13.8	13.6	14.5
Specific heat	0.2	0.2	0.2	0.2
Latent heat of vaporization, cal./gm.	32.9	34.2	28.3	28.7
Surface tension, dynes/cm.	16.1	16.8	16	17.8
Refractive index, n20/D	1.3459	1.3676		1.3526
Dielectric constant at 24.5°C.	2.1	13		
Viscosity @ 30°C., cst.	0.4277	0.513	0.715	0.041

Readers' Service Item M-10

VANSTAY Z

zinc bearing chelator for PVC resins imparts outstanding clarity, stability and resistance to sulfur staining when used as recommended with other VANSTAYS in many vinyl products.

Plastisols, Organosols, Extruded Goods

Use 1.5 VANSTAY R with .5 VANSTAY Z for maximum resistance to process heat and good service life.

Film, Sheeting, Molded Products

Use 1–1.5 VANSTAY HT with .5–1.5 VANSTAY Z to obtain the required protection.

When Roll plating is a problem:

Use 1.5 VANSTAY N with 1.5 VANSTAY Z as the stabilizing system.

Our Technical Service Representatives will gladly demonstrate the merits of our materials in your plant and assist in solving production problems.

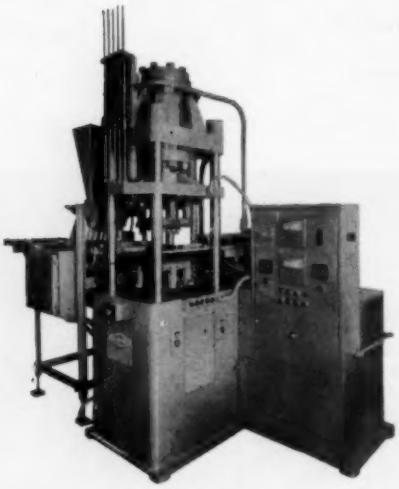
Oliver

R. T. Vanderbilt Co., INC.

230 PARK AVENUE, NEW YORK 17, N. Y.

New Equipment

Write item numbers on Readers' Service Card to obtain more information.



Baker Plasti-Matic press.

Three Compression Presses

Three automatic, hydraulic presses (one 60-ton, two 100-ton) have been introduced by Baker Brothers, Inc., P. O. Box 101, Station F, Toledo 10, O. Known as the Plasti-Matic series, the presses are designated Models 60-2016, 100-2420, and 100-3024, respectively.

The 60-ton Plasti-Matic has 20- by 16-inch platens, and features both upper and lower hydraulic ejection. General specifications include a 13-inch stroke; a maximum distance between platens of 29 inches; a hydraulic working pressure of 2,700 psi.; and a 400-inch per minute traverse. Breathing cycles are automatic, and deceleration is possible at any point in the pressing stroke. Slow break away is possible at high pressure. With the Universal Loader Board, changes in load and number of cavities can be effected in a few minutes and at no additional cost. Maximum floor space required is 62½ by 69¾ inches.

General specifications for the two 100-ton presses are reported as follows:

	Model 100-2420	Model 100-3024
Platen size, in.	24 x 20	30 x 24
Stroke, in.	15	18
Maximum distance between platens, in.	30	42
Hydraulic working pressure, psi.	3,300	3,300
Floor space required, in.	64½ x 43½	70¼ x 69¾

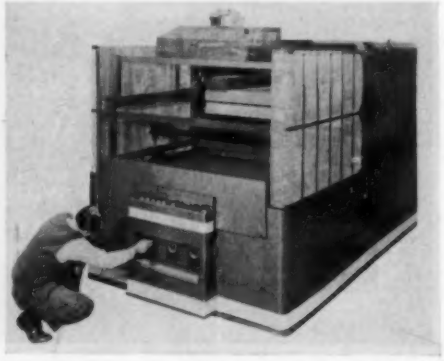
These presses can be used with either the Loader Board or a high-frequency preheater (with powder). They are also available as transfer presses with bottom transfer ram.

Readers' Service Item E-1

Drape and Vacuum Former

An automatic drape and vacuum forming machine designed specifically for the lighting industry has been introduced by Auto-Vac Co., 1984 State St. Extension, Bridgeport 5, Conn. Maximum forming area is 50 by 50 inches, which permits the production of plastic ceiling pans up to four-foot square.

Clamping frames are fully adjustable so that producers can form single, double, or four two-foot square pans on the same unit. Over-all space requirements are 74 by 127 inches; however, the latter figure should be increased by 24 inches if the pump is placed in the rear. The machine stands 78 inches high, and weighs approximately 6,500 pounds. Other changes from previous models include a three-inch port opening; a 57 by 59-inch vacuum table and drape frame; a heating area measuring 56 inches square; a 60-CFM vacuum system; a 250-gallon reservoir; 105-ampere heater load; and a production rate of better than 400 two by two-foot pans per hour.



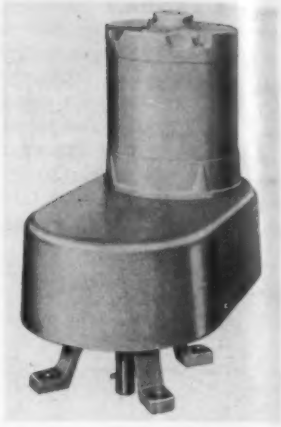
Auto-Vac's combination drape-vacuum former.

Readers' Service Item E-2

Agitator Belt Drive Unit

The Little Giant Agitator Drive Unit, designed to provide slow, positive agitation of liquids without contamination, has been placed on the market by Little Giant Products Inc., 1530 North Adams St., Peoria, Ill. All bearings are pre-lubricated and sealed against leakage. Housing is cast aluminum, and the output shaft is stainless steel.

Motors are available in single or polyphase, and are totally enclosed. Also optional are horsepowers ranging from 1/20-1/6, and dual voltages of 110, 220, and 440. A steel cable-reinforced V-belt furnishes the drive, and shaft output speeds range from 29 rpm. and up.



Little Giant Agitator Drive Unit

The unit can be made to fit all standard agitators. Floor space required is 14½ by eight inches. Height of the unit is approximately 14 inches.

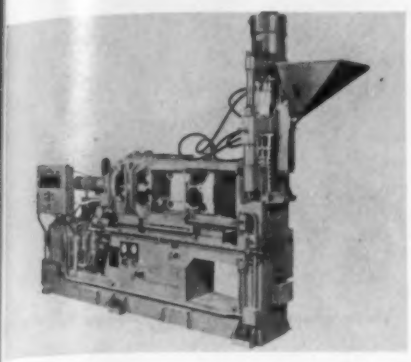
Readers' Service Item E-3

Automatic Injection Packager

The L-2-4 Ounce injection molding machine, dubbed the "package-maker," has been introduced by Lester-Phoenix, Inc., 2711 Church Ave., Cleveland 13, O. Ridgid, one-piece frame construction provides for accurate, flash-free locking, and rapid set-up is accomplished through the central adjusting screw. Specifications are reported as follows:

Capacity, oz. polystyrene/shot	4
Other granular thermoplastics, cu.in.	14.5
Oil plunger cylinder diameter, in.	8.25
Plunger pressure, psi	20,000
Total force, lbs.	55,200
Plunger speed, in./min.	169
Plunger stroke, in.	6.63
Injection stroke, sec.	2.4
Plunger displacement speed, cu.in./sec.	7.8
Beam area, sq.in.	39
Stroke, in.	6-9
Mold closing pressure, tons	125
Machine cycle, 6-in. stroke, sec.	6
Hopper capacity, lbs.	45
Total heating units, kw	10
Combined pump capacity, gal./min.	39.1
Oil reservoir capacity, gal.	65
Dimensions: Length, in.	147
Width, in.	38
Height, in.	102
Weight, lbs.	9,200

Designed to mold with and without an operator, the machine operates in competitive cycles, or molds small shots at high speeds. Particularly suitable for nylon, L-2-4 consists essentially of a vertical, elec-



Lester L-2-4 Ounce injection molding machine.

trically-heated plasticizing assembly in combination with a hydraulically-actuated toggle mechanism for locking molds.

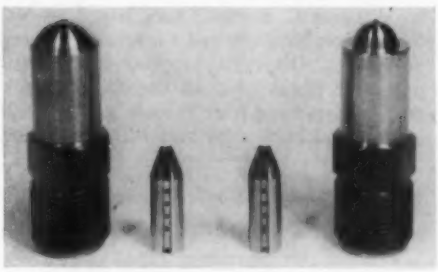
Readers' Service Item E-4

Polyliner-Type Nozzle

A polyliner-type, heated extension nozzle designed to increase plasticizing capacity and aid color mixing in injection molding machines has been introduced by Injection Molders Supply Co., 3514 Lee Road, Cleveland 20, O. Patterned after the DuPont polyliner design, the new nozzle is inserted into an extra length nozzle directly under an individually-controlled, extra-high wattage heater band.

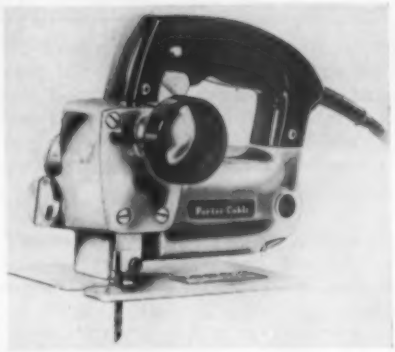
The IMS nozzle is available in lengths averaging five inches, and fits all heating cylinders with ¾-in or larger front openings. It is said to provide an easy, low-cost means for evaluating polyliner claims on a small scale. Specifications are reported as follows:

Nozzle thread, in.	1¾-8
Rear opening, in.	¾
Front opening, in.	⅛
Radius, in.	½ or ¾
Heater band requirements, in.	1½ x 1½
Voltage	110 or 220
Frontal die clearance hole, min., in.	2¾



IMS polyliner nozzle insert.

Readers' Service Item E-5



Porter-Cable's Model 148 Bayonet Saw.

Electric Bayonet Saw

An electric bayonet saw featuring orbital motion has been introduced by Porter-Cable Machine Co., Syracuse, N Y. Known as Model 148, the saw rapidly cuts through Formica and other plastics, ferrous and non-ferrous metals, and woods. In addition to its cutting plastics, the saw features a number of plastic components.

Model 148 permits plunge cuts without drilling starting holes. The 3.5-ampere motor idles at 4,500 strokes per minute, and cuts at 4,250.

The saw is 6¼ inches high and weighs six pounds.

Readers' Service Item E-6

For Higher Output
Closer Tolerances
Faster Start Ups
Lower Maintenance

Great claims? No, real facts. Let us *demonstrate* to you the superior performance of these new extruders with this exclusive combination of design features: Le/D Ratio of 20:1, Fully Automatic Thermo-Control, Herringbone Gear Transmission, Heavy Duty Thrust Assembly, Flexible Coupling and Completely Wired Control Cabinet. Available with Le/D ratios of 16:1, 20:1 and vented 24:1 in 2½", 3½", 4½", 6", and 8" sizes.

Technical bulletins No. E-2, E-3 tell you how you can get more pounds per hour of better quality extrusions.

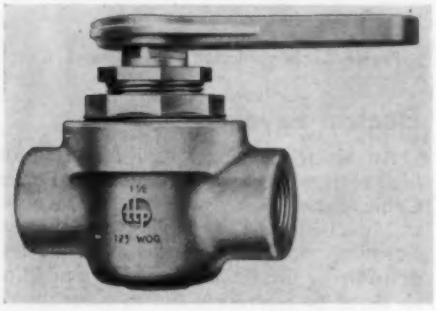
Get bulletins today.

PRODEX EXTRUDERS

PRODEX
CORPORATION
FORDS, N. J. • HILLCREST 2-2800

New Products

Write item numbers on Readers' Service Card to obtain more information.



Tube Turns' self-lubricating plug valve.

Injection-Molded PVC Valve

A plug valve with Teflon bearing buttons for self-lubrication is being injection molded of PVC by Tube Turns Plastics, Inc., 224 East Broadway, Louisville 1, Ky. The new valve is expected to reduce replacement costs and down-time, minimize purging, and eliminate product contamination problems which often occur when corrosive fluids encounter metallic components of piping systems.

A straight-through port permits unimpeded flow, various adjustments to compensate for wear, positive closing, and self-indicating port positions. A nub on the bottom can be tapped for insertion of a drain plug. Both threaded and socket-type ends are available. The valve is furnished in 1-, 1½-, and 2-inch sizes to match corresponding piping. Bushings permit adaptation of ½-, ¾-, and 1¼-inch piping. Both three- and four-inch valves are planned for future production.

Readers' Service Item P-1

Dacron-Filled Urethane Pillow

An all-synthetic pillow featuring a cover of polyurethane foam and a filling of Dacron polyester fiberfill has been introduced by Lockport Mills, Inc., 304 Elmwood Ave., Lockport, N.Y. Non-allergenic, the pillows are moth-proof and mildew-proof, as well as non-matting. They can be washed by hand or in a machine.

Unifoam polyurethane foam is produced by William T. Burnett, Inc., based on Mobay's combination of isocyanates and polyesters. Du Pont supplies the Dacron polyester fibers used in the filling. Lockport is marketing four models, all 20 by 26 inches, and both with and without ticking.

Lockport Mills' Unifoam pillow.

Readers' Service Item P-2

Butyrate Hack-Saw Handle

The new Star hack saw frame manufactured by Clemson Bros., Inc., Middletown, N.Y., features a single-member construction with a butyrate handle molded directly onto the steel. Readily adjustable for standard 10- and 12-inch blades, the frame offers proper tension through its cam-action lever-lock.

Clemson's Star hack saw frame has butyrate handle molded, directly onto steel.

The complete frame is rustproof, and the steel back comes in either glossy or crackle finish. The handle, designed in chipproof red or green Tenite butyrate, is highly resistant to oil and moisture. Tenite is a trademark of Eastman Chemical Products, Inc.

Readers' Service Item P-3

Three-dimensional acetate shadow box display

Three-Dimensional Shadow Box

Three-dimensional displays in transparent, printed cellulose acetate are being vacuum formed for U. S. Rubber Co. by Goodren Products Corp., 263 William St., Englewood, N.J. An extension of the Goodstix line of 3D displays, this self-adherent shadow box is being used to spearhead promotion of U. S. Rubber's Koylan foam. Interior features are in deep relief, and raised surfaces of the frame are adhered to the inside surfaces of windows, glass doors, and showcases.

The debossed display is printed out of register in four colors onto a continuously-moving roll of Celanese's acetate film. When formed, the sheet is readable and literally acts as a traffic-stopper.

Readers' Service Item P-4

Extruded Butyrate Panels

A modern lighting fixture for outdoor areas, featuring butyrate "wraparound" lighting panels, has been introduced by Steber Mfg. Co., 2700 Roosevelt Rd., Broadview, Ill., under the name Skyliner T. Extruded from Eastman Chemical's Tenite by Sandee Mfg. Co., the panels are hinged to the fixture so that they may be opened like doors.

Butyrate's toughness permits thin sections of exceptional clarity, and the contour also helps in producing a greater light transmission than was previously possible with this type and size of fixture. High impact strength virtually eliminates breakage during shipment, installation, and relamping.

Steber's Skyliner T outdoor lighting fixture.

Door frames, top cover, chassis, and other parts are made of aluminum. The unit is completely closed, and maintenance is virtually nil except for lamp replacements. Skyliner units are available in section lengths of 4, 8, 12, and 16 feet which can be joined end-to-end to provide a continuous lighting strip.

Readers' Service Item P-5

Reinforced Plastic Side Racks

Side racks for flat-bed truck trailers are being made by Plasti-Glas, Inc., 7000 North Interstate St., Portland, Ore., featuring

Plasti-Glas panels are easily removed.

fibrous glass-reinforced polyester panels laminated around metal stakes. Measuring 78-90 inches high, the racks fit 24-, 35-, and 40-foot standard trailers.

The racks reduce labor costs considerably, since one man can remove and stack them in less than 15 minutes. Color is mixed-in before cure, thereby eliminating the need for painting. A complete set weighing 1,100 pounds consists of front panels, sides, rear doors, aluminum bows, hardware, and attaching parts. All parts can be replaced individually.

Readers' Service Item P-6

Waterproof Contact Cement

A new contact cement for Consoweld, Formica, Micarta, and other plastic laminates has been introduced by Adhesive Products Corp., 1660 Boone Ave., New York 66, N.Y. Called Stix-Grip, the adhesive is brushed evenly onto the plastic's undersurface and over the surface to which plastic is to be bonded. About 15 minutes drying time should be allowed before joining the surface. Tackiness is not a factor.

Care should be taken in maneuvering the laminate into the exact position. Stix-Grip Thinner should be used to separate incorrectly joined surfaces, since the adhesive grabs immediately. Over-all pressure should be exerted, and the edges cut or sanded back 1/32-inch. The cement is flexible, and resistant to extremes of heat and cold.

Stix-Grip cement bonds plastic to wood.

Readers' Service Item P-7

Polyethylene Beach Sandals

Flexible beach sandals are being molded from Bakelite's polyethylene by Nu-Dell Plastics Corp., 2250 N. Pulaski Rd., Chicago 39, Ill. Designated Clog-Hoppers beach and shower sandals, they feature lightness of weight and good temperature resistance. A flexible strap hugs the arch of the foot, preventing the sandal from falling off at work or play.

Ribs are molded into the sole bottom to give a good grip in shifting sand, and in tub or shower. Abrasion resistance is reportedly excellent. The sandals are available in five sizes to fit men, women, and children.

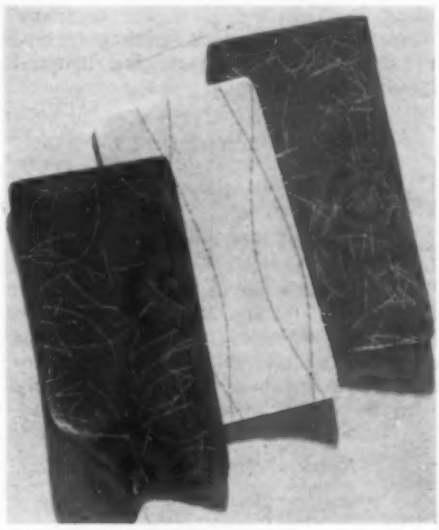
Nu-Dell polyethylene Clog-Hopper sandals.

Readers' Service Item P-8

Mylar-Felt Combination Fabric

Du Pont's Mylar polyester film bonded to soft felt by the Felters Co., 210 South Street, Boston, Mass., produces an attractive fabric with the softness of felt, and the strength and durability of polyester film. Called Mira-Felt, the material presents a stainproof surface which resists abrasion and moisture.

Mylar can be applied to fashion felt fabrics, as well as to felt bonded with Lurex thread in various colors and designs. Among the expected applications for MiraFelt are fashion apparel and accessories, industrial stylings, and auto and plane interiors.



Felters' MiraFelt, Mylar-felt combination.

Readers' Service Item P-9

Three Epoxy-Type Adhesives

Three structural adhesives designed for bonding such rigid materials as metals, glass, ceramics, hard rubber, and plastics, have been introduced by Leffingwell Chemical Co., P.O. Box 1016 Perry Annex, Whittier, Calif. Designated Lefkoweld Adhesives, Types 46, 108, and 201, the materials are based on epoxy resins which have been formulated to meet the requirements of MIL-A-5090B for aircraft structural assemblies.

Full-strength service is provided over wide temperature ranges, and the adhesives are easily handled in complex contours. They are completely solvent-free. Lefkoweld 46 should be used if a room-temperature set is required; Lefkowelds 108 and 201 for a curing temperature of 125° F. or higher. Lefko Activator F gives a rapid cure, but has a pot life of only 30-60 minutes. Lefko Activator S is slower acting, but has a pot life of several hours. Data sheets are available on all three formulations.

Readers' Service Item P-10

New Literature

Write item numbers on Readers' Service card to obtain more information.

"Directory of Plastic Packaging Suppliers, 1956 Edition." Bulletin C-6-211. Koppers Co., Inc. 90 pages. This pocket-size booklet gives an alphabetical listing of packaging suppliers according to state and city. Each listing gives the company's address, officers, stock packages, types of packagings, and packaging materials handled.

Readers' Service Item L-1

"Petrothene Polyethylene Resins." U. S. Industrial Chemicals Co. 14 pages. This second edition includes property data on Petrothenes 100 and 200; formulations of Petrothene 300 series electrical-grade resins; and electrical, thermal, chemical resistance, and film-permeability properties of polyethylene.

Readers' Service Item L-2

"A Unique Service to Industry." Luria-Cournand, Inc. 20 pages. This four-color illustrated booklet sketches the firm's history, showing its wide range of products and the techniques by which they are made. Sections cover architectural materials derived from plastics, and the company's research and development facilities.

Readers' Service Item L-3

"Farrel Speed Reducers." No. 450 Farrel-Birmingham Co., Inc. 52 pages. Complete data on the firm's line of speed reducers are contained in this illustrated booklet. Horsepower rating tables, specifications, dimensions, and weights are included.

Readers' Service Item L-4

"Model 4300 Quick-Connect Valve." NRC Equipment Division, National Research Corp. 2 pages. Specifications, physical data, special features, and dimensions of this multiple-unit filling or vacuum pumping valve are described and illustrated. Applications are said to run from drying or leak-testing of components to wheeling a single pump from experiment to experiment in a laboratory.

Readers' Service Item L-5

"Pipelines to the Future." Monsanto Chemical Co., Plastics Division. 64 pages. No. 3 in the Monsanto Business Executive Series, this highly-comprehensive market study contains detailed charts and tables comparing the performance and cost of the important plastic and metal pipe materials. Comparisons include cost in dollars per foot, working pressure, maximum tensile strength, allowable pressure, maximum working temperature, physical properties, chemical resistance, installed cost, fabrication method, and sales.

Readers' Service Item L-6

"Reed-Prentice Plastic Injection Molding Machines." Reed-Prentice Corp. 34 pages. The firm's injection molding machines are fully illustrated, including parts close-ups and schematic sketches, in this catalog. Full specifications are given, along with applications data.

Readers' Service Item L-7

"Wheelabrator Mechanical Plastics Deflashing." Wheelabrator Corp. 4 pages. Four illustrated case histories of automatic pellet deflashing of thermosetting plastic items are covered in this bulletin. Advantages are listed, along with estimated savings.

Readers' Service Item L-8

"Gauging of Drums." U. S. Industrial Chemicals Co. 2 pages. This bulletin consists essentially of two charts for gauging the contents of 55-gallon drums by stick measurement; both horizontally, and vertically.

Readers' Service Item L-9

"Salt & Water, Power & People." Robert E. Thomas. Hooker Electrochemical Co. 109 pages. A short history of the Hooker Electrochemical Co., the book's publication coincides with the fiftieth anniversary of the firm. It is intended to acquaint the reader with Hooker's growth through the years, and contains numerous illustrations.

Readers' Service Item L-10

"Hydraulic Presses for Industry." Dominion Engineer, Vol. 12, No. 6. Dominion Engineering Co., Ltd. 16 pages. Representative examples of the various hydraulic presses, designed and built by Dominion, are described and illustrated. Some of these include: a 7,000 ton forging press, plywood presses, plastic laminating presses, belt presses, die spotting presses, bulldozer press, an open gap press, and a forge-trimming press.

Readers' Service Item L-11

"Equipment for Granulating, Mixing, Drying, Coating, and Polishing." Bulletin No. 609. F. J. Stokes Machine Co. 8 pages. This illustrated catalog describes and lists specifications for Stokes' oscillating granulators, pulverizers mixers, and drying cabinets.

Readers' Service Item L-12

"Lanco Apparatus Review." No. 6. Arthur S. LaPine & Co. 12 pages. This catalog lists the firm's best-selling laboratory apparatus for 1955, together with a four-page insert introducing Harleco volumetric solution concentrates. Specifications and price data are included.

Readers' Service Item L-13

"Thermaflow Glass-Reinforced Molding Compounds." Thermaflow Chemical Corp. 7 pages. Included here is a general bulletin describing the materials; Bulletin 2C6 on molding conditions and techniques; Bulletin 2C5 listing the physical properties of the materials; and Bulletin 6C7 listing the physical properties of Thermaflow 300T, an electrical-grade material.

Readers' Service Item L-14

"How Thick Should a Rubber Roll Covering Be?" Report No. 8. Rodney Hunt Machine Co. 2 pages. The effect of rubber thickness on nip width and distribution of pressure under the nip is depicted graphically, based on a pair of squeeze rolls. Doubling the thickness increases nip width by 75%, but effects a 40% decrease in unit pressure.

Readers' Service Item L-15

"At Your Service." Bulletin 640. F. J. Stokes Machine Co. 12 pages. The brochure contains nine case-histories of how the Stokes laboratory enabled manufacturers to develop new products and/or processes. Illustrations are included.

Readers' Service Item L-16

Book Reviews

"Technical Publications—Their Purpose, Preparation and Production." C. Baker. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. Cloth, 5½ by 8½ inches, 315 pages. Price, $6.

This volume is designed as a guide for the writing of technical information in industry and the presentation of information in verbal and graphic form, rather than as a textbook on grammar or commercial art. Compiled on broad lines, the book outlines the needs of the user of technical publication, and presents useful techniques for gathering the information, writing the text, preparing hand-drawn and photographic illustrations, and reproducing the work by the various duplicating and printing processes.

The text is divided into 10 chapters covering forms of technical publicity; meeting the user's needs; the use of words; copy writing; the value of illustrations; graphic illustrations; techniques of reproduction; preparing, proof correcting, and producing; giving and getting aircraft and allied information; and legal documents. A conclusion is appended, together with a subject index. The subject matter is replete with examples and illustrations chosen from a wide range of subjects, and have been kept simple enough to make them intelligible to the average reader.

The book should be of value to all technical personnel, particularly in the engineering fields, in guiding them to the techniques of presenting information and producing it in the best and cheapest form.

"Handbook of Chemistry and Physics." 37th Edition. Editor in Chief, Charles D. Hodgman; Associate Editors, Robert C. Weast and Samuel M. Selby. Chemical Rubber Publishing Co., 2310 Superior Ave. N.E., Cleveland, O. Fabrikoid, 4½ by 7 inches, 3,178 pages. Price, $12.

This new edition of the handbook retains the general features and organization of previous editions aimed at presenting in condensed form as much accurate, reliable, and up-to-date information in the fields of chemistry and physics as would be convenient and useful. New tables of data have been added on oxidation potentials, calculation of titration data, ionization potentials, viscosity conversion factors, dielectric constants of water, dipole moments, activity coefficients, crystal ionic radii of elements, and allowable carrying capacities of conductors. New definitions have been added to the already extensive list included in past editions.

While all sections have been modernized, major revisions have been made in the information on gravimetric factors; dissociation constants of acids and bases; data on industrial organic compounds; half-wave potentials for polarographic analysis; physical constants for ozone and oxygen; properties of plastics; photographic formulas; values for the velocity of light; and properties of dielectrics. As in previous editions, the subject matter is divided into ten major sections: mathematical tables; properties and physical contents; general chemical tables; specific gravity and properties of matter; heat; hygrometric and barometric tables; sound; electricity and magnetism; light; quantities and units; and miscellaneous data.

"Kunststofftechnisches Worterbuch (Plastics Technical Dictionary)" Annemarie Wittfoht. Carl Hanser, Verlag, Leonhard-Eck Strasse 7, Munchen, Germany. Cloth or plastic, 4¾ by 7½ inches, 406 pages. Price, 35-42 DM, depending on binding ($8.35-10.00).

This plastics dictionary, which is designated Volume I, is based on the 1948 edition which gave both English-German and German-English listings. Only English to German listings are given in this volume; however, Volume II (German to English) is in process and should be available late next year.

In addition to containing up-to-date terminology, the dictionary now covers such fields as electronics and electricity, adhesives, lacquers, reinforced plastics, and textiles. German abbreviations are explained, and the appendix is devoted to the following areas of specialization: sheet fabrication, mixing, molding, and mold making. Sixty-five pages of conversion tabels follow the appendix, and numerous schematic diagrams are included.

"Effects of Radiation on Dielectric Materials." Naval Research Laboratory. Order PB 111863 from OTS, U. S. Department of Commerce, Washington 25, D. C. Paper, 171 pages. Price, $4.25.

This book includes a number of papers submitted at a Naval Research Laboratory conference in December, 1954, by representatives of the government, industry, and university laboratories. Many deal with specific radiation effects.

Included in the work are investigations on the radiation stability of polymers, concepts of radiation chemistry, chemistry of polymer formation, effects of radiation on glass, conductivity of polyethylene and Teflon during irradiation.

Wood flour is usually a high percentage of the finished product. But it's a *small* percentage of the *value* of the product. So quality and uniformity are the prime considerations in wood flour.

The new Wilner wood flour mills were engineered to provide the highest precision and automation in processing control. The plants are so completely automatic, they could be operated by pushbutton from the president's office. Continuous moisture and rotap testing guarantees that the flour, once tailored to the mix or formulation, never varies. The user is assured of wood flour milled from kiln-dried, clear white pine, free from contamination, with a low moisture content, and in any mesh size desired.

Typical Analysis
140 Mesh Wood Flour

Thru	On	
	100	trace
120		99.2
140		96
170		86
200		75.6
270		49.2

Uses of Wood Flour

Wood flour is a *filler* and *extender*, adding strength, bulk, lightness and impact resistance to other more costly materials, such as plastics, linoleum, roofing felt, molded rubber products, wall board and vinyl floor coverings. It is an ideal *absorbent* for explosives, adhesives, rug and fur cleaners, stock feeds, and fertilizers (with built in insecticides?), and an effective *mild abrasive*, for cleaning metal surfaces, such as molds.

Other prospective uses include very fine filtration work; as a *binding agent* and *moisture absorbent* in ore processing; as an *anti-binding agent* to give desired porosity after burn-out in products like firebrick.

For samples, further information and specifications, please write:

DEPT. I-2C
Wilner Wood Products Co., Norway, Me.

Abstracts of Important Articles

Materials

"Effects of Multiaxial Stretching on Crazing and Other Properties of Transparent Plastics," Irvin Wolock and Desmond George, *SPE J.*, 12, 2, 20 (Feb. 1956).

Tests were conducted to determine the effects of multiaxial stretching on various properties of several new transparent plastics. Polymethyl-alpha-chloroacrylate can be multiaxially stretched at least 150%, while Plexiglas 55 cannot be stretched more than 85%. This stretching causes a decrease in resistance to surface abrasion; a slight increase in tensile; and large increases in strain at failure and resistance to stress crazing.

"Melt Fracture-Extrudate Roughness in Plastics Extrusion," J. P. Tordella, *SPE J.*, 12, 2, 36 (Feb. 1956).

Results are given of experimental work to determine the causes of roughness in melt extrusions, and the elimination of melt fracture as a critical stress phenomenon during such extrusion.

"The Mechanics of Plastics Reinforcement in Tension," J. O. Outwater, Jr., *Modern Plastics*, 33, 7, 156 (March 1956).

A mathematical relationship is obtained for the tensile modulus of elasticity of unidirectionally reinforced plastics for both continuous and short fibers. By comparing these values, the influences of various properties of the resin and fibers on the properties of the final laminate can be shown. It is shown that adhesion between the resin and the fibers influences laminate properties only before it is preloaded.

"Prestressed Reinforced Plastics," S. Goldfein, *Modern Plastics*, 33, 8, 151 (Apr. 1956).

Flexural strength can be increased up to 50% by prestressing, when tested in the direction of prestressing. Flexural breaking strength increased up to 68%; average stiffness increased up to 47%; tensile and shear strengths were not affected significantly; compressive strengths decreased from 2-14%; and impact strength increased up to 8%. All properties, except impact, were decreased 2-33% in a direction perpendicular to the laminate prestressing direction. Prestressing appears to have a greater effect on laminates containing higher glass contents. After aging for 7-19 months, the laminates lost as much as one-third the gains obtained by prestressing.

"Preimpregnated Glass Fibers," S. G. Salzinger, *Western Plastics*, 3, 2, 15 (Feb. 1956).

A report on the weaving, finishes, and impregnation techniques for glass cloth for reinforced plastics. Types of resins discussed include phenolics, epoxies, silicones, polyesters, melamines, and others. The various methods used to mold reinforced plastics are described, together with the effects of resin content, resin flow, and post-cure on finished properties. A comparison is given of the relative merits of preimpregnated vs. wet-layup materials.

"Heat-Resistant Methylstyrene Polymers," J. A. Melchore, *Modern Plastics*, 33, 7, 163 (March 1956).

Methylstyrene made by a new monomer synthesis can be used to make molding compounds which open up new fields of application and provide moldings of higher quality. The polymer has all the desirable properties of polystyrene, plus improved heat resistance. Copolymerization with 30% acrylonitrile gives improvement in polymer toughness and resistance to heat, crazing, abrasion, and chemicals.

"Room-Temperature Bonding," J. L. Been, *Modern Plastics*, 33, 7, 126 (March 1956).

Recent advances in resins and elastomers have provided the adhesive formulator with the raw materials for adhesives having structural properties and suitable for bonding plastics. The inability to use a heat-cure no longer rules out the effective use of epoxy-base adhesives.

"The Utility of Impact Testing as a Measure of Toughness," C. H. Adams, G. B. Jackson, and R. A. McCarthy, *SPE J.*, 12, 3, 13 (March 1956).

An evaluation technique is proposed which much more accurately determines the effects of anisotropy and variations in flow behavior than do the Izod and ball-drop impact tests. Impact results of other tests are of no practical value since they are performed on standard injection-molded specimens which are uniaxially oriented and broken in the direction of maximum strength.

"Atomic Radiation and Polymers," L. A. Wall, *SPE J.*, 12, 3, 17 (March 1956).

An outline is given, in general terms, of possible mechanisms by which high energy radiation induces chemical changes in polymeric materials.

"Block Polymerization at Low Temperatures," Z. K. Jelinek, *Plaste u. Kautschuk*, 2, 10, 222 (Oct. 1955).

Starting by a reference to the method of low temperature block polymerization of methyl methacrylate or styrene, with p-toluene sulfinic acid as initiator, that was described by O. Hagger in 1948, the author discusses the influence of the oxygen from peroxides formed in methacrylates. He suggests a radical mechanism for the initiator reaction, with the sulfinic acid acting as a redox system when free radicals are formed. In support of the theory, he points to the avid absorption during polymerization of melocular oxygen, if available in sufficient quantity. The advantages of initiators in the above method of polymerization are enumerated. Problems yet to be solved when p-toluene sulfinic acid is used are accurate control of the content of peroxidic oxygen in the monomer, and a suitable polymerization technique which takes into account the effect of molecular and peroxidic oxygen. It would be interesting, the author adds, to discover whether products obtained by the method discussed would have better mechanical properties than articles made by existing methods. (In German).

Equipment

"The Effect of Heat Treatment on the Polishability of Mold Steels," E. E. Lull, *SPE J.*, 12, 4, 30 (Apr. 1956).

Carburization of certain mold steels can eliminate the influence of carbides, variations in hardness, and network on the polishability of the steels.

"The Maccaferri Injection Molding Heating Chamber," Mario Maccaferri and R. B. McKee, Jr., *SPE J.*, 12, 2, 11 (Feb. 1956).

The design and performance characteristics of a new melt-extraction heating chamber for injection molding are presented and discussed.

"The Vacuum Extruder Screw," E. C. Bernhardt, *SPE J.*, 12, 3, 40 (March 1956).

A new vacuum extruder screw is described which offers a simple, reliable method for removing volatiles from plastic materials during the extrusion process, thus eliminating the need for pre-extrusion drying of hygroscopic materials.

"Automatic Injection Molding," D. H. Lewis, *SPE J.*, 12, 3, 28 (March 1956).

A discussion of automatic injection molding machines, molding methods, and tool designs, indicating that automatic molding is suitable for small parts.

"Gage Control in Calendering of Vinyl Films and Sheeting," M. Jukich, *Rubber Age*, 78, 6, 886 (March 1956).

Results of an investigation of roll bending of calenders to determine its effectiveness in controlling gage of vinyl films and sheeting.

"Solids Conveying in Extruders," W. H. Darnell and E. A. J. Mol, *SPE J.*, 12, 4, 20 (Apr. 1956).

Equations are derived that express the conveying or advancing capacity of the feed section of an extruder screw. These equations should prove useful in designing a screw that will have the correct balance between the delivery rates of the successive screw sections.

"Fluorescent Sunlamps in Laboratory Aging Tests for Plastics," F. W. Reinhart and M. K. Mutchler, *ASTM Bull.*, No. 212, 45 (Feb. 1956).

Data are presented to show that the fluorescent sunlamp is superior to the S-1 sunlamp in that it is cheaper; has a longer service life; does not require use of a special fixture; temperatures of test specimens can be controlled more readily; larger areas of material can be exposed; and test areas are more uniformly radiated and deteriorated.

Processing

"Painting and Metallizing of Plastics," L. E. Parks, *SPE J.*, 12, 2 & 3, 17 & 35 (Feb. & March 1956).

A discussion of common problems in painting and metallizing of plastics, with suggestions for their cure or elimination.

"Advances in Thermoset Molding," E. F. Borro, *Modern Plastics*, 33, 9, 145 (May 1956).

Recent developments in equipment, techniques, and automation are described, and data are presented to show that curing time can be reduced by preheating, by using a hot mold, and by feeding the stiffest possible material.

"Potting and Encapsulation," F. G. Firth, *Modern Plastics*, 33, 8, 125 (Apr. 1956).

The properties of monomer-resin mixtures used and of the cured resins are discussed and compared with those of a hypothetical "ideal" potting resin. Curing reactions are reviewed, together with practical details of potting by the vacuum and centrifugal methods.

"Compression and Transfer Molding of Guided Missile Parts," L. B. Keller and W. R. McGlone, *SPE J.*, 12, 4, 32 (Apr. 1956).

By proper use of the compression and transfer molding techniques described in this paper, missile parts have been fabricated which meet extremely rigorous requirements. A better understanding of the molding processes must be gained, more controlled processing and new, improved materials must be developed before plastics can completely fulfill their promise as engineering materials.

Applications

"Epoxy Resins in Electrical Applications," H. Rudoff and A. J. Rzeszotarski, *SPE J.*, 12, 2, 31 (Feb. 1956).

A discussion of epoxy resins and adhesives, their chemistry and uses in electrical applications.

"Evaluation of Reinforced Plastics Materials in High-Speed Guided Missile and Power Plant Applications," A. V. Levy, *Plastics World*, 14, 3, 10 (March 1956).

A brief discussion of phenolic, silicone, and polyester reinforced plastics in aircraft missiles, with a property comparison of these plastics with light metals.

General

"Designing with Transparent Plastics," A. M. Blumenfeld, *SPE J.*, 12, 2, 28 (Feb. 1956).

Designing with such plastics requires specialized knowledge. Basic design considerations are described, and information given on the concealment of attachment devices.

"Why Color Affects Sales of Plastics Toys," Faber Birren, *Plastics World*, 14, 2, 8 (Feb. 1956).

A discussion of color preferences and buyer acceptance of color, and their influences on sales of toys.

Request for copies, reprints, or further information on any article abstracted in this department should be addressed to the publisher of the magazine where the article appeared. The publishers and their addresses are given below:

"ASTM Bulletin"
American Society for Testing Materials
1916 Race St., Philadelphia 3, Pa.

"Australian Plastics"
Australian Trade Publications, Ltd.
171 Sussex St., Sydney, Australia

"British Plastics"
Iliffe & Sons, Ltd.
Dorset House, Stanford St.
London S.E.1, England

"Canadian Plastics"
341 Church St., Toronto, Ont., Canada

"Chemical and Engineering News"
1155 Sixteenth St. N.W.
Washington 6, D. C.

"Hule Mexicano y Plasticos"
Filomeno Mata 13-11, Mexico, D.F.

"Industrial and Engineering Chemistry"
1155 Sixteenth St. N.W.
Washington 6, D. C.

"Industries des Plastiques Modernes"
Les Publications Techniques Associees
40 Rue du Colisee, Paris 8e, France

"Kunststoffe"
Carl Hanser Verlag
Leonard Eck Str. 7, Munich 27, Germany

"Kunststoff-Rundschau"
Brunke Garrels, Verlagsbuchhandlung
Borgfelder Strasse 83, Hamburg 26, Germany

"Materie Plastiche"
Via Farneti 8, Milan, Italy

"Matiéres Plastiques"
Galerie du Center, Bloc 3
Rue des Fripiers, Brussels, Belgium

"Mechanical Engineering"
American Society of Mechanical Engineers
29 W. 39th St., New York 18, N. Y.

"Modern Plastics"
575 Madison Ave., New York 22, N. Y.

"Oesterreichische Plastic-Rundschau"
Ployer & Co.
Aegidiengasse 5, Vienna 6, Austria

"Plaste und Kautschuk"
Veb Verlag Technik
12 Unter den Linden
Berlin N.W.7, Germany

"Plastic"
Danish Technical Press
31 Vester Farimogsgade
Copenhagen 5, Denmark

"Plastica"
Kunststoffeninstituut T.N.O.
Julianalaan 134, Delft, The Netherlands

"Plastics"
Temple Press, Ltd.
Bowling Green Lane, London E.C.1, England

"Plastics World"
Cleworth Publishing Co., Inc.
22 W. Putnam Ave., Greenwich, Conn.

"Plastiques Informations"
94 Rue Saint-Lazare
Paris 9e, France

"Plastverarbeiter"
Verlagsgec. m.b.H.
Herzheim b. Landau/Pfalz, Germany

"Poliplasti"
E.T.A.S., Via Andrea Mantegna 6, Milan, Italy

"Revista de Plasticos"
Inst. "Alonso Barba"
Serrano 119, Madrid, Spain

"Revue Générale des Matiéres Plastiques"
196 Ave. Jean-Jaures, Paris 19e, France

"Rubber and Plastics Age"
Rubber and Technical Press, Ltd.
Tenterden, Kent, England

"SPE Journal"
Security Bank Bldg., Athens, Ohio

Patent Digest

Materials

Copolymers of Phenolic Resin Esters and Compounds Containing a Vinyl-Benzene Nucleus. No. 2,731,428. S. A. Harrison, Minneapolis, Minn. (to General Mills, Inc.).

A copolymer of a compound selected from the group consisting of styrene, the methyl-substituted styrenes, and the chlorine-substituted styrenes, and an unsaturated higher fatty acid containing from 8-18 carbon atoms. The copolymer contains from about 5-40% of said compound by weight, based on the weight of the phenolic resin ester.

Stabilization of Vinyl Chloride Resins with Organotin Trimercaptides. No. 2,731,440. E. P. Stefl, Churchill Valley, Pa., and C. E. Best, Franklin Township, O. (to Firestone Tire & Rubber Co., Akron, O.).

A resinous composition which is stable to heat and mechanical working comprises a resin selected from the group consisting of polymers of vinyl chloride and copolymers thereof with other ethyleneically unsaturated compounds. The composition contains at least 80% of vinyl chloride copolymerized therein, together with from 0.25-5% by weight of an organotin mercaptide containing from 1-22 carbon atoms, hydrogen, carbon-carbon single bonds, carbon hydrogen bonds, up to 11 aromatic ring carbon-carbon double bonds, and up to four innocuous structures.

Stabilization of Vinyl Chloride Resins with Organotin Mercaptides of 2-Mercaptothiazole and Its Derivatives. No. 2,731,441. E. P. Stefl, Churchill Valley, Pa., and C. E. Best, Franklin Township, O. (to Firestone Tire & Rubber Co., Akron, O.).

Similar to No. 2,731,440, except that the resin is stabilized with 0.2-5% by weight of organotin mercaptides of 2-mercaptothiazole and its derivatives.

Preparation of Tetrafluoroethylene. No. 2,732,411. M. W. Farlow, Wilmington, Del., and E. L. Muetterties, Hockessin, Del. (to E. I. du Pont de Nemours & Co., Wilmington, Del.).

The process comprises reacting elemental fluorine with carbon at a temperature of at least 1,400° C., immediately quenching the reaction products below about 500° C., and removing any elemental fluorine therefrom.

Epoxide Resin Cured with a Polyhydric Aliphatic Alcohol. No. 2,731,444. S. O. Greenlee, Racine, Wisc. (to Devoe & Raynolds Co., Inc., Louisville, Ky.).

A composition comprising an epoxide resin which is a polyether derivative of a dihydric phenol having terminal epoxide groups and free from reactive groups other than epoxide aliphatic hydroxyl groups, and a polyhydric aliphatic alcohol containing only carbon, hydrogen, and oxygen and selected from the group which consists of aliphatic hydrocarbons substituted only by hydroxyl groups, polyglycols, polyglycerols, and polypentaerythritols free from oxygen-containing groups other than ether oxygen and hydroxyl groups. Said polyhydric alcohol having at least two primary hydroxyl groups as a cross-linking reactant for the epoxide resin. The proportions of epoxide resin and polyhydric alcohol are such that the epoxide groups of the resin are at least equal to the primary alcoholic groups of the alcohol.

Vinyl Chloride Resins for Application as Solvent Solutions. No. 2,731,449. E. P. Rowland, Jr., and R. A. Piloni, Pottstown, Pa. (to Firestone Tire & Rubber Co., Akron, O.).

A copolymer of 55-75% vinyl chloride; 14-35% of a dialkyl ester of an acid selected from the group consisting of maleic, fumaric, and chloromaleic acids containing 4-22 carbon atoms; 5-10% of a monoalkyl monohydrogen ester of an acid selected from the group consisting of maleic, fumaric, and chloromaleic acids containing 3-12 carbon atoms; and 1.5-6.5% trichloroethylene. The percentages are based on total weight of the copolymer.

Method of Preparing a Copolymer of 2-Chloroacrylamide and Methacrylonitrile. No. 2,731,451. J. A. Price, Stamford, Conn. (to American Cyanamid Co., New York, N. Y.).

The method of preparing a copolymer of 2-chloroacrylamide and methacrylonitrile which comprises heating together under reflux for four hours a mixture of 7.5 parts of methacrylonitrile, 2.5 parts of 2-chloroacrylamide, 240 parts of water, and 0.2 part of potassium persulfate, and isolating the copolymer thereby produced from the reaction means.

Printed copies of patents are available from the Commissioner of Patents, Washington 25, D. C. Price, 25c each.

—The Editor

Thermosetting Resins. No. 2,731,450. G. E. Serniuk, Roselle, N. J., and L. M. Welch, Madison, N. J. (to Esso Research & Engineering Co.).

A thermosetting tripolymer resin prepared by copolymerizing a mixture of 0.4-6 parts of divinyl benzene, 54.8-52 parts of butadiene, and 44.8-42 parts of diisobutylene, with a dissolved Friedel-Crafts catalyst at a temperature of —70 to +50° C.

Suspensions of Polymeric Chlorotrifluoroethylene. No. 2,732,357. M. M. Sprung, Schenectady, N. Y. (to General Electric Co.).

A liquid suspension comprising a dispersed phase consisting essentially of finely-divided, solid, high molecular weight polychlorotrifluoroethylene as the sole solid polymeric ingredient, and a dispersing medium for the solid comprising an organic liquid which is a solvent for the polymer at elevated temperatures and a non-solvent liquid oxygen-containing diluent having a boiling point above 50° C.

Process for Preparing Tetrafluoroethylene by Reacting Carbon and a Binary Halogen Fluoride. No. 2,732,410. M. W. Farlow, Holly Oak, Del., and E. L. Muetterties, Hockessin, Del. (to E. I. du Pont de Nemours & Co., Wilmington, Del.).

The process comprises reacting carbon at a temperature of at least 1,500° C. with a binary halogen fluoride, and immediately thereafter removing the halogen fluoride and any halogen of atomic number less than 53 from the reaction product.

Dicarboxylic Sulfones as Plasticizers for Vinyl Chloride Polymers. No. 2,730,512. W. D. Emerson and R. A. Heinsch, Dayton, O. (to Monsanto Chemical Co., St. Louis, Mo.).

A resinous composition comprising a polymer of at least 70% by weight of vinyl chloride and up to 30% by weight of an unsaturated monomer copolymerizable therewith. Said copolymer is plasticized with a carboalkoxybenzyl carboalkoxymethyl sulfone in which each alkoxy group has from 4-8 carbon atoms.

Equipment

Apparatus for Dusting Plastic Film and Like Sheet Material. No. 2,729,194. W. C. Jones, Midland, Mich. (to Dow Chemical Co., Midland, Mich.).

An apparatus for emitting a cloud of dust particles at a controllable rate. The apparatus comprises two interconnected superposed chambers, the upper sidewalls of the lower chamber and the lower sidewalls of the upper chamber converging to an interconnecting venturi throat between both chambers; a porous plate disposed transversely across the lower chamber near its bottom; an inlet port in the lower compartment of the lower chamber admitting an inert gas under pressure beneath the porous plate; a jacket about the upper chamber and containing means for heating

this chamber; a plurality of spaced perforations along a horizontal line on each side of the apparatus through the jacket at a level just above the venturi throat; a plurality of spaced perforations along a horizontal line through the walls of the upper chamber above the venturi throat; damper means to regulate the draft through the perforations in the outer jacket; a narrow elongated outlet port at the top of the upper chamber; means for supplying gas under pressure to the compartment beneath the porous plate; and a supply of finely divided dusting material in the compartment of the lower chamber above the porous plate.

Reclaim Processing Apparatus. No. 2,730,759. G. J. Glass, Poland, and G. L. Bruggemeier, Akron, O. (to Firestone Tire & Rubber Co., Akron, O.).

Apparatus for processing plastic materials comprising a shaft; means to drive the shaft at one end; said shaft having a feed end and a delivery end rotatable in the bore of a fixed housing and adapted to masticate said material against the walls of the bore; said shaft comprising helical screws on the feed and delivery ends; said screws being separated by a tapered portion; the wall of said bore adjacent said first screw being helically fluted and having a pitch opposite to the pitch of the cooperating shaft screw; the walls of the bore adjacent said tapered rotor having a smooth surface tapered complementally to said tapered shaft portion; and the walls of the bore adjacent said second screw having a smooth, cylindrical surface.

Method and Apparatus for Determining the Characteristics of a Thermoplastic Material. No. 2,729,967. H. S. Kaufman, New York, N. Y., and C. R. Giannotta, North Caldwell, N. J. (to M. W. Kellogg Co., Jersey City, N. J.).

The method comprises suspending at one end an elongated specimen of a thermoplastic, notched between the ends, in a heating zone; pulling the other end of the specimen at a constant tension; maintaining a substantially constant temperature in said heating zone which is between the softening temperature of the thermoplastic and below the temperature of substantial degradation; and measuring the time required for the specimen to pull apart at the notched portion.

The apparatus comprises in combination an elongated heating vessel having a passageway extending vertically therethrough to suspend the specimen; thermostat means responsive to the temperature in the interior of the vessel to control this temperature; means for insulating the heating vessel in a vertical position; time registering means; means responsive to the introduction of the specimen into the passageway for starting the timing device; and means for stopping the timer which is actuated by the falling of the specimen through the passageway.

Method and Apparatus for the Production of Crimped Filaments. No. 2,730,758. J. W. Morrell, Pottstown, Pa., and W. J. Smith, Royersford, Pa. (to Firestone Tire & Rubber Co., Akron, O.).

The apparatus for the manufacture of crimped filaments from crystalline polymeric resins comprises a melt spinning heat having a die provided with a plurality of spinning orifices arranged in a circle and directed vertically downwards, and means disposed below and coaxially with this circle for directing a radial flow of cooling gas outwardly in all directions from said axis and past the filaments extruded from the orifices.

Method for Producing Molds for Making Dolls Composed of Plastic Material. No. 2,728,980. J. L. Kallus, Brooklyn, N. Y.

Manufacturing a chambered mold having an inner mold face for a chambered plastic doll head consisting of forming a wax model; inserting independent metal parts having concave inner seat-forming faces into this wax model with outer exposed portions of the metal parts supplementing the outer face of the wax model; coating the outer face of the wax model and the outer exposed portions of the metal parts with a conductive metal; electrodepositing a metal on said coated portions to anchor the metal parts to the deposited metal wall; removing the wax from the interior of the mold wall; positioning bulbous metal protuberances on the concave inner faces of the metal parts extending from the inner face of the deposited metal wall; and extending connecting means through the deposited wall and the metal parts to connect the protuberances in place to constitute socket-forming sections in the mold and supplement the metal wall to complete the inner mold face.

Processing

Tetrafluoroethylene Polymer Bonded Heat-Resistant Fabric. No. 2,731,068. K. F. Richards, Park Forest, Ill. (to E. I. du Pont de Nemours & Co., Wilmington, Del.).

A continuous process for producing a unitary structure which comprises arranging in superposed relation a plurality of continuous plies of woven fabric which have previously been impregnated with a polymeric material preponderantly tetrafluoroethylene and dried; lightly pressing successive portions of the assembled plies to form a coherent structure; and subsequently heating successive portions of the coherent structure at a temperature above the fusion point of the material in the absence of any applied pressure to weld all of the material into a continuous length of laminate.

Method and Apparatus for Forming Reinforced Tubing. No. 2,731,070. W. E. Meissner, New York, N. Y.

A method for forming a flexible tube comprising helically wrapping a plastic strip into a tubular shape with its edges in contiguity, while concomitantly guiding a preformed helical reinforcing element longitudinally into position along the contiguous edges of the strip; coalescing the material of the contiguous edges to the element; and then setting the tubular assembly of element and strip.

Apparatus comprises a hollow mandrel; means for mounting the mandrel for rotation about a vertical axis; means for helically winding a continuous plastic band around the mandrel and simultaneously advancing the convolutions thereof downwardly and axially of the mandrel; means adjacent the upper end of the winding means for guiding a preformed helical reinforcing element into helical disposition about the mandrel; and means for applying heat to the preformed helical element, this heating means being positioned outside the mandrel and adjacent to the guide means.

Applications

Plastic Die Model and Method of Making Same. No. 2,729,894. H. V. Andrews, Wayne, Mich.

A close dimension plastic die model comprising a unitary outer honeycomb structure formed of a plurality of substantially vertical primary cells of plastic-impregnated fibrous material, and a plurality of groups of smaller substantially vertical plastic filler cells, one group disposed within each of the primary cells. These groups of filler cells are formed separate from the primary cells, and each group is engaged at its outer boundaries with the adjacent primary cell. The filler cells are formed of a stable material of high compressive strength. A lightweight core extends substantially to the top level of the primary cells. A core of lightweight, stable plastic having high compressive strength is disposed within the primary and filler cells, and extends short of the tops of the filler cells. A layer of low-shrinkage surface plastic, which remains stable over a relatively large range of temperatures, extends over and above the face of the honeycomb structure and into the primary and filler cells.

Inflatable Toy Device. No. 2,731,768. E. D. Harrowe, Hollis, N. Y. (to Ideal Toy Corp., Hollis, N. Y.).

An inflatable toy device comprising a main body portion and a plurality of separate, inflatable limb portions relatively movable with respect to the main body portion. Each of the limb portions are associated with the body portion by means of a hollow connector element permitting automatic inflation and simultaneous relative movement between the limb and body portions upon inflation of the body. Adapter elements are secured to the body portion and to each limb portion for airtight, movable association with the connector element. The connector element has a series of unconnected grooves perpendicular to the axis of the connector; these adapter elements having preformed complementary grooves for permitting a readily rotatable fit between the adapters and connector.

Industrial News Briefs (Cont'd. from p. 408)

National Polymer Products, Inc., Reading, Pa., announced a price reduction of approximately 40% on its Nylasint nylon powders. These powders are made in small particle sizes, and can be supplied with various inert fillers to provide specific properties.

Polychemicals department, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., reduced the price of adipic acid from 32-35¢ per pound, delivered in carload and truckload quantities, effective May 1. Adipic acid is used as an intermediate in the manufacture of nylon, and for making adipate plasticizers, polyesters, enamels, and other products.

Bassons Industries Corp., New York, N. Y., has been awarded a contract for a projector screen by Akely Camera & Instrument Corp. The screen, made of plastic, is part of a simulator device used by the Air Force to train personnel in aerial gunnery.

Carbide & Carbon Chemicals Co., New York, N. Y., has reduced prices of its Cellosolve hydroxyethyl cellulose, a water-soluble protective colloid and thickening agent, by as much as 16¢ per pound, depending on quantity, for the WP-09, WP-3, WP-40, and WP-300 grades. The new prices range from $1.00-1.17 per pound.

Wrenn Paper Co., Middletown, O., turned over all of its processes, converting equipment, etc., used in the making of blotting paper to Sorg Paper Co. on June 1. After this date, the entire capacity of the Wrenn Mill will be devoted to making saturating papers for the laminated plastics industry.

Badische Anilin und Soda Fabrik, Ludwigshafen on Rhine, Germany, has been licensed by Phillips Petroleum Co., Bartlesville, Okla., to use the Phillips catalytic process for making polyethylene and other polyolefin plastics. The agreement gives BASF exclusive use in Germany of Phillips patents and technical knowledge for producing this new family of polyolefins.

Claude P. Bamberger, Inc., and its affiliate, Claude Bamberger Molding Compounds Corp., have moved to larger quarters at 1 Mount Vernon St., Ridgefield Park, N. J. Formerly in Brooklyn, N. Y., the firms will occupy a new factory building and have leased a tract of land, all for the purpose of reprocessing plastic scrap.

Current Market Prices

Price Changes and Additions

Coating Resins

Acryloids	lb.	.30 /	.87
Amberlacs	lb.	.2625/	.2875
Amberols, phenolic types	lb.	.2125/	.375
Rosin maleic types	lb.	.21 /	.345

Colors

Cabot carbon blacks:			
Black pearls 2	lb.	.70 /	.78
71	lb.	.32 /	.40
74	lb.	.24 /	.32
81	lb.	.084 /	.135
0	lb.	.12 /	.19
Carbolac 2	lb.	.70 /	.79
Elf 0	lb.	.12 /	.19
Elftex 3, 5, 8	lb.	.085 /	.135
Monarch 71	lb.	.32 /	.40
74	lb.	.24 /	.32
81	lb.	.095 /	.16
Sterling R	lb.	.0525/	.0925
S	lb.	.045 /	.0875
Supercarbovar	lb.	.47 /	.54
Claremont PX-Series pastes:			
Black	lb.	1.58 /	1.68
Blue	lb.	2.50 /	2.60
Browns	lb.	1.37 /	1.47
Green	lb.	2.76 /	2.86
Grey	lb.	1.30 /	1.40
Ochre	lb.	1.27 /	1.37
Orange	lb.	1.48 /	1.58
Silver	lb.	1.45 /	1.55
White	lb.	.91 /	1.01
Yellows	lb.	1.58 /	2.55
Williams colors & pigments:			
Blacks, iron oxide	lb.	.1425/	.145
Browns, iron oxide	lb.	.1525/	.155
Burnt umbers	lb.	.0775/	.095
Greens, chromium oxide	lb.	.42 /	.4875
Reds, 100 series, 1,000 series, RV series	lb.	.1375/	.14
Kromas	lb.	.1375/	.15
Yellows, iron oxide	lb.	.115 /	.1225

Dispersing Agent

Tamol 731	lb.	.185 /	.1875

Fillers

Albacar 5950, 5960, 5970	ton	50.00 /	55.00
Anhydrous calcium sulfate, W-1320	ton	47.00 /	52.00
Barytes, No. 1	ton	45.00 /	65.75
Maglite	lb.	.2525/	.26
Marinco	lb.	.105 /	.13
Sparmite	ton	80.00 /	105.00

Finishes

Logoquant colors	gal.	3.25 /	6.30
Toy gloss, acetate	gal.	2.35 /	4.30
Metal	gal.	2.45 /	4.10
Polystyrene	gal.	2.45 /	4.70

Plasticizers

Good-rite GP-233, -235, 236	lb.	.40 /	.55
GP-261, -265, -266	lb.	.305 /	.455
Monoplex DBS	lb.	.64 /	.665
DCP	lb.	.2925/	.32
DOS	lb.	.58 /	.605
S-38	lb.	.215 /	.24
S-70	lb.	.3925/	.42
S-71	lb.	.45 /	.475
Paraplex S-B	lb.	.29 /	.3475
AL-111	lb.	.32 /	.3275
G-20	lb.	.76 /	.7675
G-25	lb.	.76 /	.77
G-40	lb.	.4825/	.51
G-50	lb.	.39 /	.4175
G-53	lb.	.4325/	.46
G-60, -61	lb.	.3325/	.36
G-62	lb.	.3525/	.38
RG-2	lb.	.41 /	.6575
RG-7	lb.	.33 /	.335
RG-8	lb.	.505 /	.5125
RG-10	lb.	.52 /	.5275

Resins & Molding Compounds

Melamines

Fiberite 2015 (black & pastels)	lb.	.57 /	.62
Pelleted	lb.	.61 /	.66

Phenolics

Fiberite 1078	lb.	.425 /	.435
1087, 1165, 1270, 1271, 1330, 1332, 1347, 1389, FM-1132, FM-3510, FM-3515	lb.	.395 /	.40
1153 (red only)	lb.	.46 /	.465
1167	lb.	.3925/	.3975
1333, FM-10365, FM-11678	lb.	.67 /	.675
1346, FM-927	lb.	.415 /	.42
1346 (red only)	lb.	.445 /	.4525
4030-190	lb.	.78 /	.81
4031	lb.	.625 /	.63
FM-926	lb.	.435 /	.44
FM-1132 (pellets), FM-14111	lb.	.42 /	.425
FM-1914, FM-1996	lb.	.38 /	.385
FM-11547, FM-17610	lb.	1.07 /	1.08
FM-11679	lb.	1.29 /	1.30
FM-17067	lb.	.83 /	.835

Polyesters

Diall 50-01	lb.	2.90 /	3.00
50-51	lb.	3.25 /	3.50
50-52	lb.	3.50	
51-01	lb.	.87 /	.98
52-01	lb.	2.25 /	2.50
52-20-30	lb.	1.50	
Vibrin 114, 117, 152, 154	lb.	.34	
115A	lb.	.38	
121	lb.	.46	
135	lb.	3.00	
142	lb.	.50	
151	lb.	.35	
152LS-4	lb.	.355	
153	lb.	.40	
X-1633-A	lb.	.49	
X-1636-W	lb.	.585	
Vygen 110	lb.	.27 /	.31
1101, 1150	lb.	.425 /	.50
2201	lb.	.48 /	.55

MAJOR CHEMICAL COMPANY STARTING PLASTICS DIVISION

Needs 2 Regional Sales Managers and 1 Technical Service Manager

Regional Sales Managers for New York and Chicago.
Technical Service Manager for Los Angeles.
As a new resin producer, we want aggressive, experienced men capable of hiring and training assistants. You will start fresh with a wonderful opportunity for growth in this brand new division.
Write us in detail about your experience and references. All inquiries will be treated confidentially and answered promptly. Interviews can be arranged anywhere. Address Box 62.

PLASTICS TECHNOLOGY
386 Fourth Avenue, New York 16, N.Y.

Domestic Production and Sales of Plastics and Resin Material, January and February, 1956

Following are the partly estimated and revised statistics for the domestic production and sale of plastics and resinous material during the months of January and February, 1956. Units listed are in pounds, dry basis unless otherwise specified. Data on alkyds and rosin modifications have not been included since their use is primarily limited to the protective coating industry.

Very little change is noted from last month's figures; however, considerable gains over last year have been made with respect to urea and melamines, styrene, vinyls, and polyesters.

	January		February	
	Production	Sales	Production	Sales
Cellulose Plastics:[1]				
Cellulose acetate and mixed ester:				
Sheets, under 0.003 gage	1,487,069	1,461,819	1,621,351	1,655,097
Sheets, 0.003 gage and over	1,314,344	1,200,490	1,210,740	1,143,167
All other sheets, rods, and tubes	706,607	585,947	613,116	623,076
Molding and extrusion materials	6,491,894	6,413,458	7,178,343	6,959,419
Nitrocellulose sheets, rods, and tubes	518,768	514,008	496,715	467,259
Other cellulose plastics	450,274	327,932	500,659	450,217
TOTAL	10,968,856	10,503,654	11,620,924	11,298,235
Phenolic and Other Tar-Acid Resins:				
Molding materials[1]	19,714,593	17,635,473	20,279,205	16,620,349
Bonding and adhesive resins for—				
Laminating (except plywood)	5,981,360	3,913,192	5,223,052	3,913,845
Coated and bonded abrasives	1,510,004	1,473,003	1,409,304	1,303,040
Friction materials (brake linings, clutch facings, and similar materials)	1,940,983	1,592,237	1,891,214	1,635,045
Thermal insulation (fiber glass, rock wool)	5,173,179	4,788,116	4,645,642	4,783,099
Plywood	3,479,067	2,845,914	4,040,099	3,233,986
All other bonding and adhesive uses	2,726,120	2,720,703	2,591,770	2,359,361
Protective-coating resins, unmodified and modified except by rosin	2,743,116	2,494,781	2,623,757	2,255,468
Resins for all other uses	2,881,562	2,564,078	2,718,724	2,428,964
TOTAL	46,149,984	40,027,497	45,422,767	38,533,157
Urea and Melamine Resins:				
Textile-treating and textile-coating resins	4,263,135	4,205,728	5,506,728	5,507,519
Paper-treating and paper-coating resins	2,209,455	1,930,055	2,465,351	2,005,804
Bonding and adhesive resins for—				
Plywood	8,767,636	7,916,795	9,326,232	8,442,473
All other bonding and adhesive uses, including laminating	3,397,389	2,396,953	2,058,679	1,854,021
Protective-coating resins, straight and modified	3,225,629	2,460,652	3,170,927	2,263,436
Resins for all other uses, including molding	7,773,867	7,898,754	7,150,245	6,560,088
TOTAL	29,637,111	26,808,937	29,678,162	26,633,341
Styrene Resins:				
Molding materials[1]	38,597,258	33,049,888	32,289,279	32,779,480
Protective-coating resins, straight and modified	9,848,946	7,767,009	7,650,344	8,395,073
Resins for all other uses	8,404,915	8,257,215	8,111,413	8,690,034
TOTAL	56,851,119	49,074,112	48,051,036	49,864,587
Vinyl and Vinyl Chloride Resins:[2]				
Polyvinyl chloride and copolymer resins (50% or more PVC)for—				
Film (resin content)		6,496,363		6,849,224
Sheeting (resin content)		4,928,499		5,295,839
Molding and extrusion (resin content)		16,842,315		16,509,162
Textile and paper treating and coating (resin content)[3]		6,176,010		5,187,440
Flooring (resin content)		5,180,595		4,894,360
Protective coatings (resin content)		2,288,852		1,791,574
All other uses (resin content)		6,584,001		6,184,688
All other vinyl resins for—				
Adhesives (resin content)		3,331,112		2,717,816
All other uses (resin content)		10,628,175		8,696,282
TOTAL	66,889,609	62,455,922	61,606,746	58,126,385
Coumarone-Indene and Petroleum Polymer Resins	21,196,145	20,095,966	18,678,300	18,938,959
Polyester Resins	5,509,812	4,533,450	5,366,218	4,065,774
Polyethylene Resins	42,721,139	40,067,722	41,415,886	38,378,211
Miscellaneous Synthetic Plastics and Resin Materials:				
Molding materials[1] [4]	3,920,716	3,394,256	3,584,299	3,326,361
Protective-coating resins[5]	595,453	391,924	706,883	415,444
Resins for all other uses[6]	10,200,079	9,149,564	9,313,317	8,691,867
TOTAL	14,716,248	12,935,744	13,604,499	12,433,672
GRAND TOTALS	294,640,123	266,503,004	275,444,538	258,272,321

[1]Includes fillers, plasticizers, and extenders.
[2]Production statistics by uses are not representative, as end use may not be known at time of manufacture.
[3]Includes data for spreader and calendering-type resins.
[4]Includes data for acrylic, nylon, silicone, and other molding materials.
[5]Includes data for epichlorohydrin, acrylic, polyester, silicone, and other protective-coating resins.
[6]Includes data for acrylic, rosin modifications, nylon, silicone, and other plastics and resins for miscellaneous uses.
SOURCE: United States Tariff Commission, Chemical Division.

Industrial News Briefs (Con't. from p. 426)

Farrel-Birmingham Co., Inc., Ansonia, Conn., moved its Chicago office on May 1 to new and larger quarters at 10725 S. Western Ave.

Machinery Sales Co., Los Angeles, Calif., has been named West Coast sales representative for Sealomatic Electronics Corp., Brooklyn, N. Y., manufacturers of electronic heat-sealing equipment for the plastics industry.

Food Machinery & Chemical Corp.'s chemical divisions, New York, N. Y., recently made the first overseas shipment of its Dapon resin, a solid prepolymer of diallyl phthalate made by the firm's Ohio-Apex Division. The shipment was made to A. Arnaud, Paris, France, importers of industrial chemicals.

Dow Chemical Co., Midland, Mich., had moved its St. Louis, Mo., sales office to a recently-completed office building in suburban Clayton. The new quarters are at 10 S. Brentwood Blvd., St. Louis 5, and are managed by Glenn H. O'Neal. The office handles Dow plastics, general chemicals, magnesium, and agricultural chemicals.

Vacuum Forming Corp., Port Washington, N. Y., has appointed Rainville Co., 647 Franklin Ave., Garden City, N. Y., as sales representative for its Vacform machinery in New England, northern New Jersey, and New York State.

M. W. Kellogg Co., has announced the establishment of a western regional office in San Francisco, Calif., with William R. Dunn directing the operation in the capacity of sales manager. The office itself will be located in the Russ Building.

Monsanto Chemical Co.'s plastics division has more than doubled its capacity to produce cyclic urea resins for textile finishing, with the completion of new facilities at Everett, Mass. This material is available under the trademark of Resloom E-50.

CALENDAR of COMING EVENTS

September 19
SPE New York Section, Gotham Hotel, New York City

September 26
SPE New York Section, Reinforced Plastics Group, Tufaro's Restaurant, Corona, L. I., N. Y.

October 11-12
SPI New England Section Conference, Wentworth Hotel, Portsmouth, N. H.

December 4-5
SPI Film, Sheeting, and Coated Fabrics Division Conference, Commodore Hotel, New York City

INDEX TO ADVERTISERS

JUNE, 1956

Acheson Dispersed Pigments Company	373
Allied Chemical & Dye Co.	Second Cover
Baker Castor Oil Co.	360
Barber-Colman Co.	362
Godfrey L. Cabot, Inc., Plastics Chemical Division	368
Carbide & Carbon Chemicals Co.	Fourth Cover
Coast Manufacturing and Supply Co.	358
Detroit Mold Engineering Co.	409
The Dow Chemical Company	366-7
The English Mica Co.	413
General Tire & Rubber Co., Chemical Division	364-5
B. F. Goodrich Chemical Company	376
Goodyear Tire & Rubber Co., Chemical Division	357
Hercules Powder Company, Cellulose Products Department	371-372-403
Metal & Thermit Corp.	361
Metasap Chemical Co.	370
Monsanto Chemical Company	363
National Rubber Machinery	Third Cover
Oronite Chemical Co.	374
Prodex Corporation	417
Rubber Corporation of America	414
R. T. Vanderbilt Co. Inc.	415
Wilner Wood Products Company	421

Positions Open

Classified Rates $5.00 per Inch.

POLYESTER TECHNICAL SERVICE

Our growing position in resins for the reinforced plastics industry has created an immediate opening for a plastics engineer for laboratory and field work—on customer problems. Sound technical know-how of the materials, equipment, and techniques involved is a particular requirement for this opportunity in an expanding situation. Please submit detailed resume to:

HOOKER ELECTROCHEMICAL COMPANY
Industrial Relations Department
Niagara Falls, New York

INJECTION MOLDING SHOP SUPERVISOR

Substantial firm, up to 100 oz equipment. Write stating experience IN DETAIL—technical and educational background and salary desired. Reply to Box 58.

PLASTICS TECHNOLOGY
386 Fourth Avenue, New York 16, N.Y.

JOB OPPORTUNITY IN PLASTIC DEVELOPMENT

With a successful, progressive, well established Michigan manufacturer. Man with imagination, technical background in plastics, some sales experience, and ability to initiate and complete plastics development projects.

Prefer at least five years experience in plastics field. Knowledge of thermoplastic and thermosetting resins, techniques used in molding, extruding, laminating, bonding, casting, calendering, etc.

To develop and expand present plastic pipe extrusion operation into further lines.

Should have growth potential for advancement to job of higher responsibility.

Send complete statement of qualifications to, Box 61,

PLASTICS TECHNOLOGY
386 Fourth Avenue, New York 16, N.Y.